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Electrical World

A McGRAW-HILL PUBLICATION

NOVEMBER 8, 1947

Features

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Armor Rodding 220-Kv Lines While Hot
How to Recruit Young Engineering Graduates

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Electrical World

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November 8, 1947

Contents

Vol. 128, No. 19

This Week's Cover Picture

The possible effect of an atomic bombing on electric utility systems has long been a subject of speculation by utility engineers and management. The results found at Hiroshima provide much valuable data on this vital topic. This view of the Senda-Machi station of Chugoku Electric Supply Co Ltd is typical of the damage wrought. For further details, see page 98.

News of the Electrical World 82

Editorials ..... 81 and 90

Washington Comment 91

500-Kv Test Program Studies Higher Voltage Transmission 92

Rewinning the Campus—Prerequisites to Successful Recruiting 96
ARCHER E. KNOWLTON, Senior Associate Editor

Japanese Appraisal of Atomic Bomb Damage to Hiroshima Utility System 98
R. M. VAN DUZER, JR, The Detroit Edison Co, and
E. J. BURGER, The Ohio Public Service Co

Procedure for Armor Rodding 220-Kv Transmission Lines While Hot 104

Substation Design Remains Flexible with Erecticon Assembled Sections—I 106
E. V. SAYLES, Consumers Power Co

Locating Faults in Underground Cables 109
DOUGLAS F. TULLOCH, Boston Edison Co

HOW 112

Engineering Reference Sheets ..... 117 and 120

Load Building 134

New Equipment 140

News About People 161

Manufacturers and Markets 171

New Electrical Construction 174

Recent Rate Changes 177

Index of Advertisements 188

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Electrical World — Editorials

NOVEMBER 8, 1947

The Road Back—World War II

FOR SOME MONTHS, the necessity for new and large scale foreign aid has been urged on the American people. If the U. S. is to contribute up to $20,000,000,000 worth of materials and products to Europe, it will continue to strain an already-taut economy. Over several years, such a program will require "something new" to be added. Presently, that "something new" looks like a return to some of the priority controls of war time. Today, no one can spell out exactly what this would mean. But if one assumes major foreign aid, priorities on steel seem inescapable.

There is considerable question as to how much farther than steel the return to priorities would have to go. In the realm of non-edible materials, steel is the key shortage, the only continuing one. Most other shortages, one is assured, rest primarily on steel. The thinking is that other materials may only have to be allocated off and on.

Another possibility implicit in the foreign aid picture is production scheduling. Interior Secretary Krug's report on the resources which the nation could devote to foreign aid hints broadly at scheduling of electrical equipment output. Its benefits are two. Maximum output may be had from scheduling; and the competition of non-preferred orders can be lessened. Possibility of scheduling is seen in Krug's comment that, after 1949, U. S. electrical manufacturers can supply domestic needs of about 4,500,000 kw annually and furnish an additional 500,000 to 1,000,000 kw for export. The joker is whether that much equipment, that late, would begin to meet Europe's needs. The reason exportable equipment would be so little is found in Krug's comment that "on the basis of experience, it seems unlikely, under ordinary conditions, without government scheduling and control, that production will exceed 75 percent of estimated capacity." Thus, to the extent that scheduling could close the gap between capacity and performance, the chances that it will be invoked are real.

Another possibility at which the Krug report hints is standardization—a major war-time expedient. It is particularly real in view of the emphasis which major electrical manufacturers are putting on the subject today.

All this is front-line stuff to the power business. Major foreign aid means new competition for materials and equipment which the industry needs badly. It might mean that some of the industry's best men will have to return to Washington. It means that, to a greater or lesser degree, electrical manufacturers will be less closely tied to the power industry and more closely tied to government. After all, under a priority system, government would be the source of materials. Also, government, not the manufacturer, would inform old customers that they must stand aside while newcomers get delivery.

Finally, major foreign aid could affect power loads. It could affect them to the point of reviving an Office of War Utilities. Krug mentioned capacity allocation—over the next five years. Presently, this seems to be an extreme view. But it is one of the possibilities for which the industry must prepare.

★ ★ NEWS OF THE

Market Survey and Research Project Suggested to NEMA

President Edwards at Annual Meeting Points Out Program Would Assist Members in Judging the Market in Advance—1948 Range and Water Heater Promotion Will Be Expanded

A SUGGESTION that NEMA launch a market survey and research program and cooperate with other trade associations "in the distribution chain" in maintaining a continual and current reporting system on potential future markets for electrical goods was made by R. Stafford Edwards, retiring president of the National Electrical Manufacturers Association, at the association's twenty-first annual meeting in Atlantic City last week.

Such a project, he explained, would be a vital link to the tremendously valuable figures already compiled by NEMA's statistical staff and could be carried out with but little added cost. The suggested program would give every member factual information enabling him to "see the red light soon enough" and aid in the accurate formulation of his market potentials.

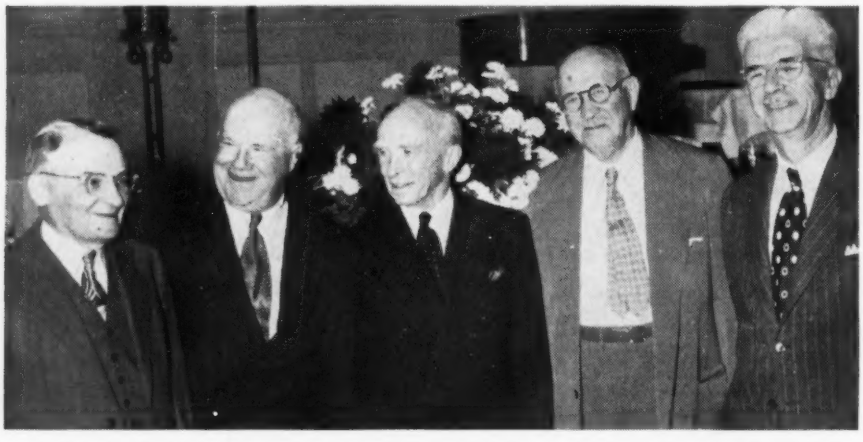
"Everyone knows that any market research result has to be continuously checked and adjusted month-to-month to be sure that actual conditions are following the expected pattern. There is a dangerously long span between purchase of raw material, its fabrication into a finished product, and the steps of distribution through wholesaler, contractor or dealer and up to actual customer purchase or installation.

"Many a manufacturer has found his Friday's backlog transformed on Monday into a tremendous over-inventory by cancellations and refusals to buy because pipe lines were filled up at the end.

"Such a condition is definitely foreseeable at the end of the distribution chain, but the average manufacturer is not in a position to get the red light soon enough. He hasn't the capacity to be at every end point. He hasn't the capacity to cover even the middle points of distribution to see the ultimate red light in time," Edwards said.

Such a plan as he outlined would, Edwards asserted, show individual companies where they had been, where they were going, and how to plan to get there.

Greatly expanded promotional programs for the coming year were announced by the Electric Range and Electric Water Heater Sections of NEMA.



CITED by NEMA for long service to the industry were, left to right, A. H. Timmerman, J. S. Thompson, C. L. Collens, F. P. Fuller, and W. F. Hurlburt.

The 1948 electric range campaign will be more than double the size of the 1947 program and will be directed to architects, builders and contractors, schools, and prospective home owners. The electric water heater promotional program will also be substantially stepped up.

These disclosures came on the heels of a comment by Edwards that some of NEMA's market promotion programs do not live up to the high standards that have been established for the association's service projects. "It might be charged," he said, "that some of them fall short of having enough time, attention, and money to do a complete job."

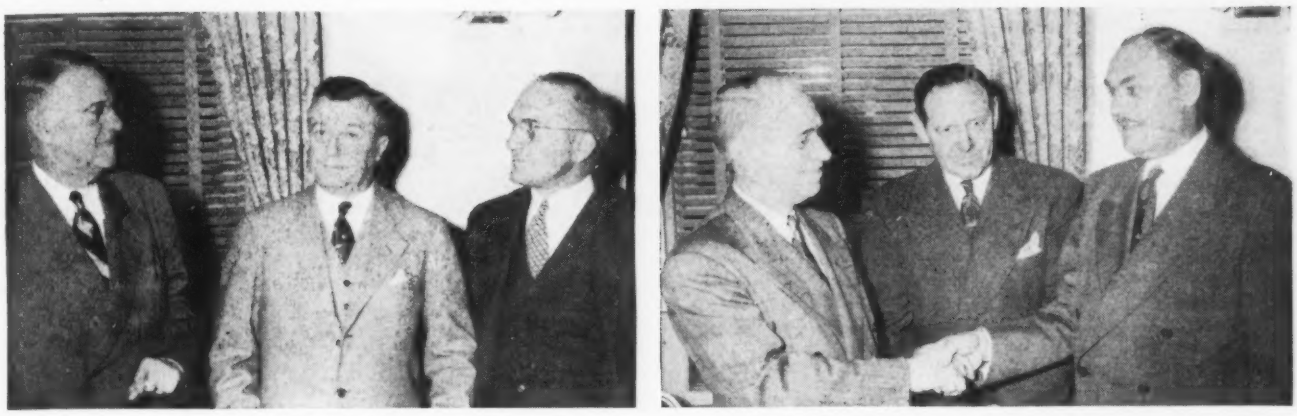
"Perhaps we have been too ambitious at the start. Perhaps the same amount of money spent on half as many projects would bring those projects closer to top efficiency. Perhaps one project at a time with adequate financing is the effective limit of an association such as ours," he stated.

Five members received gold certificates in recognition of 50 years or more of continuous service to the industry. The presentations, which were made at the annual luncheon, were given to: Clarence L. Collens, chairman of the board, Reliance Electric & Engineering Co; F. P. Fuller, vice-president, Graphite Metallizing Corp; Wilbur H. Hurlburt, president, Automatic Switch Co; Joseph S. Thompson, president, Pacific Electric Manufacturing Corp; and A. H. Timmerman, vice-president, Wagner Electric Corp.

William C. Johnson, executive vice-president in charge of the General Machinery Division of Allis-Chalmers Manufacturing Co, Milwaukee, was elected president.

Three new members of NEMA's Board of Governors were also elected: J. H. Ashbaugh, vice-president, Westinghouse Electric Corp; D. F. G. Eliot, vice-president, Western Electric Co, and J. J. Nance, president of Edison General Electric Appliance Co.

Two new vice-presidents were also named: B. W. Clark, vice-president of Westinghouse Electric Corp, and Whipple Jacobs, president of Belden Manufacturing Co. J. K. Johnson, National Vulcanized Fiber Co, was re-elected a vice-president. E. E. Potter, vice-president, General Electric Co, was elected treasurer.



NEMA OFFICERS, left panel, Vice-Presidents B. W. Clark, left, and J. K. Johnson, Treasurer E. E. Potter. Right panel, Governors J. H. Ashbaugh, left, and J. J. Nance with Retiring President R. Stafford Edwards

Chicago Utility Policy Must Precede Franchise Ruling

By Julius C. Meier

CHICAGO—Public hearings on a new Commonwealth Edison Co franchise ended last week (Oct 31) after councilmen called for adoption of a "basic utility policy."

As the open hearings ended, negotiations went into the back room for what looked like a protracted stay. The curtain came down after adoption by Council of a motion "that the Council Committee consider and adopt, at least tentatively, a basic utility policy to be pursued and to be binding upon the representatives of the Committee and, after having determined that policy, that counsel be instructed to obtain the best possible terms from Commonwealth Edison for consideration."

Following the end of open hearings, engineers and counsel of both parties met to discuss basic charter terms. Admittedly, the Council is considering terms which, for practical purposes, amount to public ownership, Alderman Clarence P. Wagner, utilities committee chairman, declared.

Indications that negotiations will be protracted came from both parties. One Council member declared that it will be well into 1948 before Commonwealth's final terms could be evaluated. Then will follow discussion on another basic question—"Which is to be preferred, a new franchise or municipal ownership?"

No committeeman would discuss the ultimate result. Still, indications continue to favor the ultimate granting of a new franchise.

Before open hearings ended, Irving H. Flamm appeared for the Public Ownership League to assert that in 23 cities of 50,000 or more population, a customer using 25 kwhr gets a 28 percent better break than in Chicago. He added that in these cities, a 40-kwhr user gets an 18 percent better break, and a 100-kwhr user about 20 percent better terms. (*Ed. Note: The Federal Power Commission's 1947 Report on Typical Electric Bills listed more than 220 cities of 50,000 population or more.*) Flamm added that the lower capital and administrative costs, lower interest rates, and the tax advantage of public ownership could not fail to work for the benefit of the customer.

Francis X. Busch, counsel for Commonwealth, explained the legal problems involved and recited past local history on utility franchises. Then after he answered 25 of the 26 questions presented by Council when the hearings opened, (ELECTRICAL WORLD, October 25, Page 85), he asserted that "our answer to the committee's question on compensation is that we believe the present 3 percent rate (gross receipts franchise tax) is fair. That figure . . . will permit the company to expand facilities and increase the demand for public service and, so far as reasonably apprehended, without an increase in rates."

Busch noted that this rate has been in effect while returns from the tax mounted from $250,000 in 1908 to more than $3,500,000 last year. Speaking on the length of the franchise, Busch declared it should be sufficient "to enable the company to render adequate service to the public at reasonable rates and maintain its credit, thereby permitting sound financing and long-range planning in the development of its utility system."

•

Crowley Quits Standard Gas; C. A. Johnson Elected

Leo T. Crowley, chairman and president of the Standard Gas & Electric Co since 1938, has resigned from both positions as of November 29. Standard Gas is being reorganized to conform with provisions of the Public Utilities Holding Company Act.

A large block of stockholders has opposed the reorganization plan of the "Crowley faction" as being too slow. It is believed that Crowley's resignation will speed the reorganization of the company. C. A. Johnson, executive-vice-president, has been elected to succeed him.

TRANSFORMER and 2.3-kv line of the Bangor Hydro-Electric Co at Bar Harbor, Me., are attacked by fire as a residence burns during the recent forest fires

1947 Motor Output Valued at $500,000,000 by NEMA

Dollar value of electric motor products to be produced in this country in 1947 is placed conservatively at $500 million. This value was announced by E. E. Helm, chairman, NEMA Motor and Generator Section, at a press conference October 30, in New York.

Faced with a backlog totalling 23 million motors and generators of all types up to 200 hp, the electrical manufacturing industry since V-J Day has spent approximately $75 million in expanding and improving plant and equipment facilities, Helm stated. Shortage of some materials complicates closing the gap between supply and demand. The backlog is shown in the accompanying table.

Unfilled Orders
Motors and Generators

Item	(June 30, 1947) Units	App. Value
Fractional HP	21,249,024	$286,011,863
Integral HP (1-200 HP)		
A. A-C Polyphase	1,378,901	154,354,514
B. A-C Single-Phase	508,158	38,609,844
C. Direct Current	53,701	15,707,543
D. M-G Sets	12,550	7,467,250
Total	23,202,337	$502,151,014

Backlog, March 31, 1947—22.2 months
June 30, 1947—15.2 months

The motor orders piled up as a result of unprecedented peace-time demands and despite the motor manufacturers' productive efforts. The condition directly reflects several significant trends. Among those specifically cited by the NEMA spokesman were:

1. Marked increase throughout the manufacturing industries in the motorizing of machinery to secure maximum economies by cutting production costs.
2. Steadily broadening use of motor drives on machine tools.
3. Growing dependence by more and more American families upon motor-driven household appliances.
4. Continued growth in rural electrification and the further development of suburban residential areas.

•

BPA-Utilities Sales Pact Given Approval by FPC

Recently concluded agreements between the Bonneville Power Administration and five utility companies were approved last week (Oct 30) by the Federal Power Commission.

Terms of the agreement call for total energy deliveries by BPA of 335,000 kw at load factor of not less than 60 percent to the companies. This energy will be divided as follows:

Portland General Electric Co, 130,000 kw; Puget Sound Power & Light Co, 97,000 kw; Pacific Power & Light Co-Washington Water Power Co, 97,000 kw; Mountain States Power Co, 11,000 kw.

The agreements were approved for two years, beginning September 1, 1947. The energy provided is to be made available after Bonneville has supplied power requirements of all its other customers during this period. The agreements call for restricted use of the capacity during critical water periods. Rates paid by the companies will be a combination of BPA's "C" and "F" rates, plus a diversity charge for delivery where made at more than one point.

FPC's approval order asserted that the agreement would permit higher utilization of Bonneville's facilities.

REA Approves Terms for SPA-Co-op Contracts

Rural Electrification Administration has approved contractual terms by which the Southwestern Power Administration proposes to sell energy at wholesale to REA-financed cooperatives in Texas. But neither agency is certain when any co-ops will sign contracts.

REA and SPA last week (Oct 30) agreed on a "model contract," which provides the form of agreement to be signed with the co-ops. Only blanks in the "model" are those to be filled by each co-op in specifying the amount of energy to be purchased, the points of delivery, maximum power capacity, and voltage.

Possible point of trouble is the clause which provides that SPA or the Texas Power & Light Co will supply all facilities necessary to deliver power at voltages and delivery rates required by the co-ops. SPA officials are reported to believe that, under the contract they signed with TP&L last spring, the company is obligated to install all facilities, including substations, to enable the agency to serve its "preferred" customers. Independent observers and even some REA representatives contend that the company is not bound to undertake such construction, though it may be inclined to do so.

Only alternative, in event that company refused to install necessary substations, would be for SPA to put in the facilities, according to terms of the REA-SPA accord. This probably would require additional Congressional appropriations for SPA, since that agency's present construction funds are either obligated already or earmarked for other projects.

Another "gimmick" in the agreement is its provision that the contracts be of 15 years' duration, followed by an escape clause permitting the co-op to cancel upon two years' notice.

Rate provisions call for a demand charge of $1.35 per kw of billing demand which includes 200 kwhr per kw per month. In addition, SPA will collect an energy charge of 4 mills per kwhr for all energy delivered over and above the kwhr covered by the demand charge.

At least two co-ops were known to be prepared to sign contracts with SPA. However, both are reported awaiting a decision on who will build the substations necessary to obtain SPA power.

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Southern Co Opens Office

The newly organized Southern Co has opened offices in the William-Oliver Building in Atlanta.

UTILITY REPRESENTATIVES at SEE Sales Conference, left panel, Hugh G. Isley, left, Carolina Power & Light Co; Les M. Taylor, Mississippi Power & Light Co; S. S. Bradford, Potomac Edison Co. Right panel, Roy H. Knox, left, Birmingham Electric Co; A. Clay Stewart, Kentucky Utilities Co; and H. E. Cox, Birmingham Electric Co

Taboos Scrapped as SEE Sales Group Meets at Atlanta

LP Gas Competitors Charged with Misleading Statements —Electric Utilities Sales Managers Criticized for Lack of Intensive Selling—Adequate Wiring Importance Stressed

COMMENTS usually taboo were commonplace last week (Oct 30-31) as the Southeastern Electric Exchange held its sales conference at Atlanta. LP gas competitors were not only mentioned but were accused of making misleading statements concerning their product and service. Sales managers of electric utilities came in not for praise but for criticism that they have not yet regained their habits of good selling which they lost during the war and show no inclination to exert themselves during the present capacity shortage.

Ralph P. Wagner, head of the Commercial Section of Edison Electric Institute, emphasized that the day will soon be here when utility sales forces will have to work hard for new load. It will take two years for the utilities to get going on productive selling. It is just common sense to do that preparatory work now. He urged immediate action on the Planned Lighting Program and warned that utilities that delay stand a chance of losing from 25 to 50 percent of their lighting load.

A wide discussion of the type of sales campaigns being conducted by LP gas was made by J. R. Poteat, chairman of the electric range section of NEMA and manager of the range and water heater division of General Electric. He pointed to some of the misleading statements being made which he cautioned utilities to watch closely and be alert to correct. Poteat suggested that the LP gas companies be brought under public service regulations as are other utilities.

Not market, but circuit. saturation will be the limiting factor on electric appliance production, asserted T. J. Newcomb, Westinghouse Electric Corp. This is the time, he declared, to sell adequate wiring, while appliances are comparatively short and before the coming buyer's market sneaks up on the industry. Maybe it is a good thing, he said, that the making of appliances is hampered by the steel shortage and other difficulties. If production were up to manufacturing capacity, then the capacity of power systems would be a matter of even greater concern.

When appliance supply catches up and distribution costs rise as selling becomes harder, then the present narrow margins between costs and prices will cause trouble, said Gerald Hulett, Electromaster, Inc. Manufacturers have possibilities of relief in production economies, but dealers and distributors will be strictly up against it.

Samuel B. Williams, Sylvania Electric Products, Inc, warned that the prewar pace of load building will not be fast enough to match post-war ability to produce electrical goods. Moreover, the high cost of the construction program ahead of the utilities will require greater revenue per installed kilowatt. Little or nothing can be hoped for from rate increases; the only answer is more productive selling.

The construction program of electric utilities puts them in competition with industrials and others for money, said J. F. Crist, Southern Co. The only way utilities can be successful in that competition is to show earnings, and to do that requires selling.

Budgets for advertising of electric utilities average about ¾ of 1 percent of their gross revenues. That is not enough, said H. S. Metcalfe, president, Public Utilities Advertising Association. And utility advertising men do not have enough voice in shaping policies affecting their field of operations. They are generally conceded by their bosses to know "how" to tell the public, but too often the "what" to tell is out of their hands.

About 22,500,000 customers visit

PROMINENT at the Sales Conference of the Southeastern Electric Exchange were John W. Talley, left, Exchange executive secretary; Gus Jaeger, Hotpoint, Inc; McGregor Smith, president of the Exchange and of the Florida Power & Light Co; R. S. Bell, Commonwealth & Southern Corp; and James F. Crist, vice-president of the Southern Co and chairman of the conference

RALPH P. WAGNER, left, New York Power & Light Corp vice-president and EEI Commercial Section chairman, and J. T. Newcomb, Westinghouse Electric Corp Appliance Division sales manager, at SEE Sales Conference at Atlanta

utility offices monthly. Here, according to Davis M. DeBard, Stone & Webster Service Corp, is an excellent and generally overlooked opportunity to tell folks about the values of electrical living and at small cost. He advised working installations of appliances in offices for demonstration of their advantages.

Management should turn an attentive eye on the potentialities of the commercial market for electric service, advised Paul D. Brooks, Ebasco Services, Inc. The retail stores of the country will spend $3 billion on rehabilitation and improvement in the next four years. The market for service is still comparatively undeveloped. In his paper, Mr Brooks detailed the organization of a sales force to build load in this field.

As chairman of the National Farm Electrification Conference, Frank E. Watts explained its purposes and urged even larger utility participation in them. A greater agricultural output per unit of labor, land, and investment is necessary. To this improvement of production, electric service can contribute greatly and it is the utilities responsibility to see to it, as much as lies in their power, that that contribution is made.

•

Heads Florida Commission

Jerry W. Carter has been elected chairman of the Florida Railroad and Public Utilities Commission for the unexpired term of the late W. B. Douglass. His term will run until January, 1949.

Utilities Finding Answers to Increasing Plant Costs

Improvement of Boilers Helpful PEA Equipment Group Told —Inhibited Oil Use Discussed

Answers to rising costs for steam plants are being found in larger units, standardization, reheat, higher temperatures, centralized controls, and simplified maintenance. This was brought out by J. B. McClure, General Electric Co, in a resume of trends at the meeting of the Pennsylvania Electric Association's Electrical Equipment Committee on October 30-31 in Philadelphia. Of the new capacity on order 85 percent is steam and of that 91 percent is for 900 F or higher. There is one unit on order for 1,100 F operation. He credited the improved design of boilers with the popularity of unitized plants and of reheat.

A single boiler for a 145-Mw unit is under contemplation, McClure stated. Variable-speed coupling-drivers are increasingly popular for feed pumps as well as fans. Simple radial auxiliary systems and isolated-phase buses are having growing adoption.

Merits of inhibited transformer oils were discussed by C. L. Seelbach, Shell Oil Co, in terms of laboratory tests and some recently initiated service-life runs. Pronounced improvement in neutralization number, power factor, and interfacial tension tests was claimed, the latter being assigned increasing significance. Seelbach said filtering should never be necessary if an inhibited oil is used in a good transformer thoroughly clean when the oil is added.

Discussion brought out that the objective for oil should be to achieve the highest duty compatible with longest life of both insulation and oil. Another point raised was that the utilities would want support of transformer manufacturers before switching to inhibited oil. Still another was that there should be some way of ascertaining how much inhibiter remained in oil after purification, especially of blends.

On a widely flung system the transportation of apparatus oil in bulk to a central treating plant cannot be justified, said L. J. Gill, Pennsylvania Power & Light Co. On that system new equipment using bauxite is being tried out with promising results. The aim in the studies is to achieve a mobile equipment and a process that will necessitate no sampling test, dependence being placed wholly on so many hours of treating with so many pounds of treating agent for so many gallons of oil.

Points of disagreement in connection with standardization of unit substations are gradually being resolved, said E. B. Shew, Philadelphia Electric Co, but discussions are continuing on such items as (1) basic one-line diagrams, (2) barriers, (3) provision of roominess despite the demand for compactness, (4) arrangement of voltage transformers. D. A. Griffith, Allis-Chalmers Manufacturing Co, asserted that industrials are large users of unit substations and their needs would have to be considered.

•

100,000th Customer Added

Louisiana Power & Light Co has connected its 100,000th customer, the 50,000th having been connected seven years ago.

Changes in Capacity Reported to Federal Power Commission

Plant Additions During September

Utility	Plant	Fuel	Capacity (Kw)
Idaho Falls Electric Light Dept	Idaho Falls	IC	1,000
Idaho Power Co	Upper Salmon	H	16,500
Center Municipal Electric Light	Center, Colo.	IC	343
Garkane Power Association, Inc	Torrey, Utah	IC	236
Garkane Power Association, Inc	Hatch, Utah	IC	236
Central Power & Light Co	Three Rivers, Tex.	IC	100
Accomack Northampton Electric Cooperative	Parksley, Va.	IC	703
Virginia Electric & Power Co	Rosemary	S	2,500
Miller Light & Power Dept	Miller, S. D.	IC	473
Hyannis Municipal Light Dept	Hyannis, Neb.	IC	148
East Palestine Electric Lights Works	East Palestine, Ohio	S	2,000
Spencerville Board of Public Affairs	Spencerville, Ohio	IC	475
Oxford Light & Water Dept	Oxford, Ind.	IC	300
Commonwealth Edison Co	Calumet	S	107,000
Illinois Power Co	Havana	S	40,000
Western Michigan Electric Cooperative	Scottville, Mich.	IC	1,100
Dairyland Power Cooperative	Alma, Wis.	S	18,000
Green Mountain Power Cooperative	Essex County, Vt.	IC	4,000

Plant Retirements During September

Otter Tail Power Co	Lake Preston, S. D.	IC	120
Buffalo Light Dept	Buffalo, Kan.	IC	100

H—Hydro; IC—Internal Combustion; S—Steam.
United States capacity as of October 1—Steam 35,275,225 kw, Hydro 14,862,720 kw, Internal Combustion 1,239,313 kw, Total 51,377,258.

Novel Theory of Rate-Making Getting Wisconsin Court Test

Telephone Company Fights PSC Order Which Reduced Rates Without Particular Reference to Value of Property—Hope Natural Gas Case Cited by Commission in Making Ruling

By Richard N. Larkin

MADISON, WIS.—A Wisconsin judge heard arguments this week (Nov 3) on the novel question of whether utility rates may be set without particular reference to the value of utility property.

The arguments came in Dane County's Circuit Court as attorneys for the Commonwealth Telephone Co sought reversal of a Wisconsin Public Service Commission rate order. The order reduced rates in Two Rivers by about $10,000 yearly. Earlier, Commonwealth had obtained an injunction preventing the rate schedule from becoming effective.

On the ruling in this case might depend the validity of another order whereunder the PSC gave a $6,400,000 rate increase to the Wisconsin Telephone Co. This order was not appealed.

Traditions Abandoned

Crux of the Commonwealth appeal was the PSC's contention that it is not bound by the traditional concept of property value in setting utility rates. On that basis, the PSC failed to determine a rate base for Commonwealth's Two Rivers property. Nor did it establish a rate of return.

Instead, it prescribed rates "estimated and intended to afford approximately an annual net profit of a determined number of dollars which we think it reasonable for the utility to enjoy from the operation of its business."

In taking so unorthodox a view, the PSC based its position on the U. S. Supreme Court's decision in the Hope Natural Gas case. That ruling, handed down early in 1944, made it clear that utility regulators are no longer bound to any formula or combination of formulas in determining rates. Only the result, however achieved, the court held then, is of consequence.

In determining the new Two Rivers rates, the Wisconsin PSC asserted that it considered three factors:

1. An estimate of reasonable future costs.

2. The point at which a rate would lose, rather than gain, revenue.

3. A reasonable profit.

In justifying its position, the PSC's rate order cited the Hope case as authority for its conviction that the very basis of utility rate regulation has changed. Before the Hope case, it said, rates were regulated under the concept of "eminent domain." This concept permits state control or use of private property but requires just recompense. Under the Hope case, the PSC went on, utility rate regulation is based on the concept of the government's right to control or use private property without consideration to recompense. The PSC very carefully points out that it does not believe in requiring utilities to serve without profit. But it does contend the profit need not be controlled precisely by the value—or cost—of the property. It can be set, PSC argues, on the basis of what the commission finds to be reasonable.

Sceptics who predict overturn of the Two Rivers order attack it from two points. They say that it departs from the Hope case in that even the Federal Power Commission, which issued the Hope rate order, found a rate base and a rate of return. Neither was found in the Two Rivers order. The courts, they go on, will have to scan all the evidence and then reconstruct the PSC's thinking to get any idea of whether the rate package is just and reasonable, as required by the Hope case. They wonder, pointedly, whether the court will go to this much trouble.

The sceptics argue, also, that the PSC violated Wisconsin law in failing to value the property. Also, they allege other failures to follow Wisconsin's Administrative Procedures Act to the letter. The PSC, in turn, argues that the Wisconsin courts followed the Supreme Court on "fair value" only reluctently. Now that the Hope case has overturned "fair value" and all its attributes, the PSC insists, there is no reason to believe that the Wisconsin courts will insist upon it.

PSC spokesmen acknowledge that the Two Rivers order, if validated by the courts, would bring a "new freedom" to utility regulation. They profess full awareness of the "new responsibility" for sensible, sound rate making which the "new freedom" would entail. The dismay with which Wisconsin utility executives survey the Two Rivers order is not based on any suspicion of the existing Wisconsin Commission. Rather it is an unwillingness to give any such blank check jurisdiction on rates to future commissions—as yet unnamed.

The PSC, finally, insists that the Two Rivers doctrine is not just another way of forcing a rate cut when the record cannot be made to justify one. As proof of this, Commission people point to a second rate order issued on the same basis as the Two Rivers decision. The second order granted that $6,400,000 rate increase to the Wisconsin Telephone Co. That order, say the PSC spokesmen, shows that the commission is not just exploring a one-way street.

IRKING CONGRESSMEN is Russ Nixon, extreme left, of the United Electrical, Machine & Radio Workers, CIO, by his statement before a House Labor Subcommittee that Congressmen get as much as $12 an hour. He urged that minimum pay be raised from 40 to 75 cents an hour. Listening to the testimony are Congressmen George MacKinnon, left, Wint Smith, Chairman S. K. McConnell

Reclamation Will Present 6-Year Plan to Congress

The Bureau of Reclamation will present its $2,148,000,000, six-year construction program to Congress early next year. Purpose of the presentation will be to get Congressional support for "a uniform and assured" schedule of irrigation and power projects for the future.

First indication that the Bureau was aiming at this goal of some $300,000,000 of Reclamation work per year came last winter when its branch of power utilization produced a six-year, $801,000,000 program of power projects (ELECTRICAL WORLD, March 8, Page 3). This program, slightly modified, was included in the over-all $2,148,000,000 plan revealed last week (Oct 30) by Interior Secretary Krug and Reclamation Commissioner Straus at the National Reclamation Association Convention.

Bureau personnel conceded that it would be "unrealistic" to "sell" Congress such a long-range program in one package. They will not seek money or authorization for the six-year plan (All its projects already have been authorized). They will ask Congress for $295,000,000—less any carryover of funds from the current fiscal year—in new appropriations for fiscal 1949. They plan "expenditures" for the next five fiscal years as follows: 1950, $408,000,000; 1951, $422,000,000; 1952, $398,000,000; 1953, $354,000,000; 1954, $271,000,000.

Completion of this program, Secretary Krug said, would mean construction of "less than half of the presently authorized" Reclamation projects.

The power report of the Bureau called for installation by 1952 of 2,752,000 kw of new capacity, including 50,000 kw in plants to be built in the West by the Army Engineers. Secretary Krug reported that the Bureau now hopes to add 2,269,600 kw of capacity by the end of the same fiscal year.

According to the Bureau's earlier report, an additional 3,030,000 kw would be provided "after 1952." This would include 560,000 kw in Army-built plants. Krug estimated that the Bureau would add 2,276,000 kw of capacity after 1952. By 1954, he added, this program also would bring 4,000,000 acres of land under new and supplemental irrigation.

•

10,000-Kw Contract Signed

Bonneville Power Administration has contracted to supply the Carborundum Co, Niagara Falls, N Y, with a 20-year supply of Columbia River power for operation of the company's plant to be constructed at Vancouver, Wash. The contract provides for delivery of 10,000 kw beginning not later than April 1, 1949. The $2,000,000 plant will manufacture abrasives and other related material.

•

Duff Appoints Committee to Pick Strike Arbitrators

Gov. James H. Duff of Pennsylvania has taken steps to avert a repetition of last year's lengthy strike of Duquesne Light Co employees. Acting under the anti-strike law passed last June, he has appointed a twelve-man labor-management committee. These men will select a panel of arbitrators from which the governor will select twelve. If the need arises, he will select the arbitration board from this panel.

Labor members of the committee include George L. Mueller, president of the independent union which carried on last year's strike. Both the American Federation of Labor and the Congress of Industrial Organizations are represented. Management members are all connected with utilities, though not all are electric.

•

30,000-Kw Plant Planned

Arkansas-Missouri Power Co has announced that it will erect a 30,000-kw steam generating plant near St. Francis, Ark. The "outdoor" type plant will be built in such a way as to provide for an ultimate capacity of 120,000 kw. Natural gas will be used for fuel, and provision will be made to use oil if needed. Cost will be $5,000,000.

•

Utility Rebuilds System

Washington Water Power Co has rebuilt its distribution system in Altamont, Wash., at an estimated cost of $100,000. The utility constructed 140 blocks of 13-kv lines in alleys to replace 2.3-kv lines in streets.

MEETINGS

Previously Listed

Pennsylvania Electric Association—Communications Committee, Lord Baltimore Hotel, Baltimore, November 13-14.

American Society Of Mechanical Engineers—Annual Meeting, Chalfonte- Haddon Hall Hotel, Atlantic City, December 1-5.

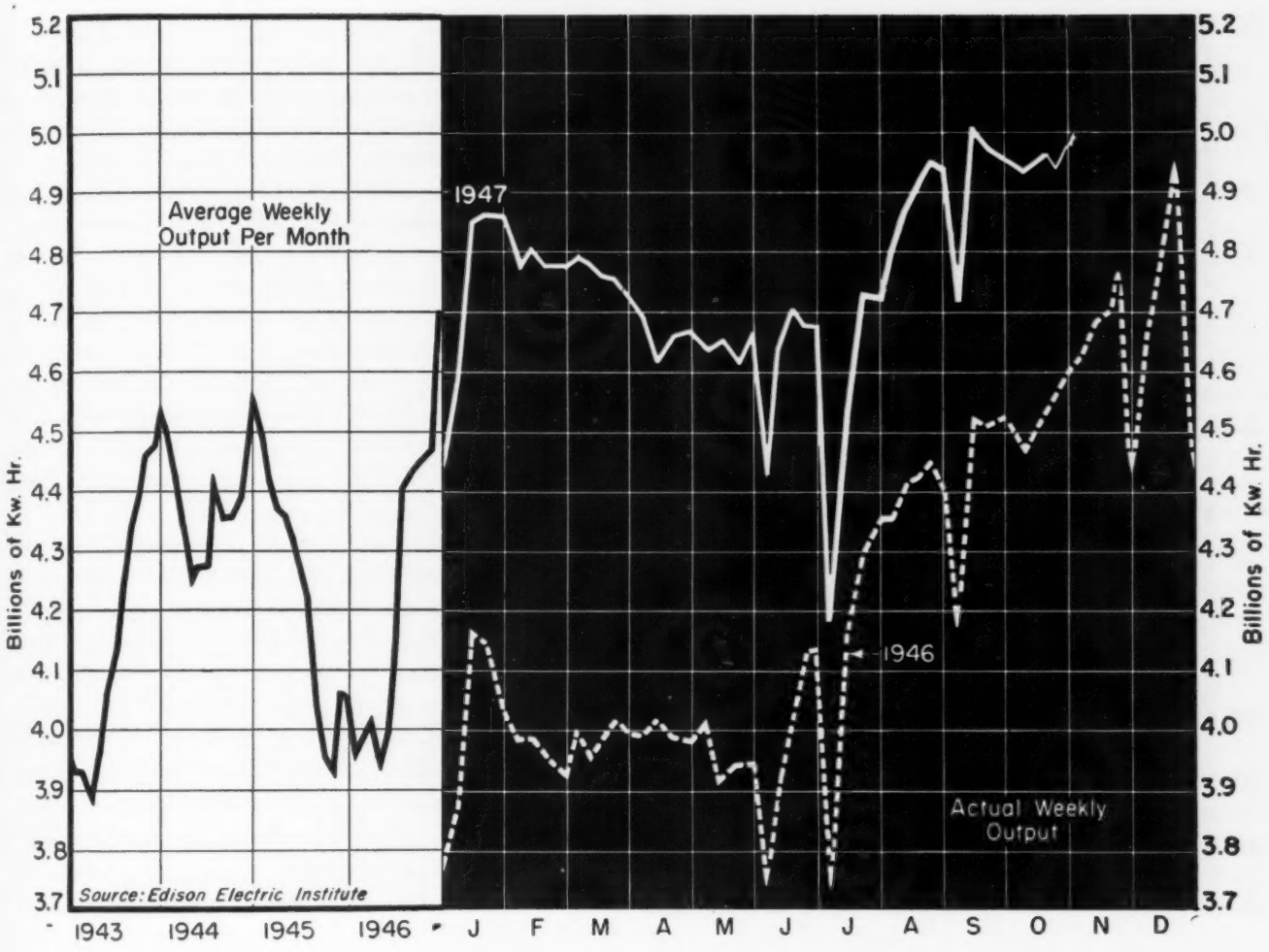
SEC RULINGS

AMERICAN LIGHT & TRACTION Co's amended plan of reorganization, filed jointly by the company and its parent, United Light & Railway Co, is still on the SEC calendar. The commission recently denied a motion by its public utilities division to dismiss the amended plan in its entirety. Denial of the motion, however, was without prejudice to its renewal when the entire case is submitted to the commission on completion of hearings. One of the provisions of the amended plan was that within two years after it became effective American Light would have disposed of all shares of common of Detroit Edison Co and Madison Gas & Electric Co, held by it, and United Light & Railway would have disposed of all of its holdings and preferred and common of American Light, as well as all distributions received by it from the latter company. This provision was opposed by the public utilities division on the ground that the proposed two-year period did not constitute an expeditious method of compliance with Section 11 of the Holding Company Act and with the commission's divestment order of August 5, 1941. The commission cautioned the two companies that they "must bear full responsibility for any delay" which may result after the conclusion of the hearings, should the agency find it necessary to disapprove the plan because it does not contain "adequate assurances" that compliance with the act and the commission's outstanding order will be effected expeditiously. (Release No. 7778).

AMERICAN POWER & LIGHT Co's application for authority to make temporary advances to its subsidiary, Texas Utilities Co, in amounts not to exceed $7,000,000 has been approved. Texas Utilities in turn, plans to use the loans to make contributions to Texas Power & Light Co and to Texas Electric Service Co in the aggregate amount of $3,000,000 and also to advance up to $4,000,000 to Dallas Power & Light Co for construction. Dallas will repay such borrowings out of the proceeds of permanent financing which is contemplated prior to next September 30, 1948, and Texas Utilities will repay to American such sums as it receives from Dallas. To repay the sums loaned to Texas Power and Texas Electric Service, Texas Utilities intends to sell common stock to the public following the sale or other disposition by American of more than 50 percent of the stock of Texas Utilities under American's plan. (Release No. 7783).

CENTRAL MAINE POWER Co's proposal to borrow $7,000,000 (including $3,000,000 of notes now outstanding with the First National Bank of Boston) has been approved. Funds will be used to complete 1947 construction program and for other cash requirements. (Release No. 7798).

NIAGARA HUDSON POWER CORP has been granted an extension to May 1, 1948, of the time within which it must dispose of all its interest in Buffalo Niagara Electric Corp and all the latter's subsidiaries. SEC also granted to the holding company an extension of time to Nov. 1, 1950 of the maturity of all of Niagara Hudson's obligations to banks under its credit agreement dated July 12, 1945. (Release No. 7800).



Plans Underway to Sell Puget Utility to 13 PUD's

Individual contracts for purchase of the Puget Sound Power & Light Co, outside the "Seattle competitive area," have been transmitted to commissioners of 13 public utility districts in western Washington, according to Guy C. Myers, fiscal agent for the PUD's.

The contracts designate John Nuveen & Co of Chicago to handle the bonds to be issued separately by the districts. The general conditions are the same as those invalidated by a decision of the Washington Supreme Court, under which the Skagit County PUD was to have issued $135,000,000 in bonds to take over the entire system.

When all districts have signed their bond contracts, Myers plans to propose to Frank McLaughlin, president of Puget Power, immediate steps for the transfer of the Puget properties, other than those in Seattle and vicinity, which Puget presumably will sell to the City of Seattle. The PUD proposal will be a reaffirmation of the previous offer of the PUD's to buy the company on the basis of $18 a share of common stock, accompanied by notification that the districts have their financing arranged and are ready to proceed.

The amount of bonds to be issued by the 13 PUD's is expected to be in excess of $110,000,000. Each of the PUD's will take over the distribution lines within its border except for the Chelan PUD, which also will operate lines in Douglas and Grant Counties.

Three counties—King, Pierce, and Island—in which company property lies have no PUD's. Seattle would purchase most Puget Power properties in King County while Island County lines would be divided between Snohomish and Skagit County PUD's. This would leave only rural Pierce and King County properties unattached to any specific PUD. Presumably these properties might be handled by a non-profit corporation or by a continuation of the Puget corporate structure.

Other News

New Equipment	Page 140
News About People	161
Manufacturers & Markets	171
Construction	174
Recent Rate Changes	177

Output Hits 5 Billion

The electric output curve moved upward to the second highest point on record during the week ended November 1, 1947, according to figures released by E E I. The amount of electrical energy distributed totaled 5,009,286,000 kwhr, comparing with 4,963,816,000 kwhr during the preceding week. The record high is 5,053,300,000 kwhr for the week ended September 13, 1947. During the week ended November 2, 1946, the amount of electrical energy was 4,628,353,000 kwhr, this year's increase being 8.2 percent.

Weekly Output, Millions Kwhr

1947		1946		1945	
Nov. 1	5,009	Nov. 2	4,628	Nov. 3	3,899
Oct. 25	4,964	Oct. 26	4,602	Oct. 27	3,937
Oct. 18	4,946	Oct. 19	4,540	Oct. 20	3,915
Oct. 11	4,958	Oct. 12	4,495	Oct. 13	3,934
Oct. 4	4,935	Oct. 5	4,478	Oct. 6	4,028
Sept. 27	4,956	Sept. 28	4,518	Sept. 29	4,039
Sept. 20	4,977	Sept. 21	4,507	Sept. 22	4,019
Sept. 13	5,053	Sept. 14	4,521	Sept. 15	4,106
Sept. 6	4,721	Sept. 7	4,184	Sept. 8	3,909
Aug. 30	4,940	Aug. 31	4,404	Sept. 1	4,137

Percent Change from Previous Year

	Nov. 1	Oct. 25	Oct. 18
New England	+ 9.1	+ 8.7	+ 6.1
Mid-Atlantic	+ 7.7	+ 6.5	+ 6.6
Central Industrial	+10.9	+ 8.6	+11.7
West Central	+11.7	+10.8	+ 9.2
Southern States	+ 8.4	+ 9.0	+10.1
Rocky Mountain	+ 5.4	+ 9.8	+ 9.6
Pacific Coast	+ 2.6	+ 4.4	+ 5.5
Total United States	+ 8.2	+ 7.9	+ 9.0

Electrical World
OPINION

Non-Dollar Dividends

ALONG WITH THEIR CUSTOMERS, Maine's power systems recently faced the forest fires which did so much damage to homes and other property. Numerous lines were destroyed, along with the homes they served. But word from the stricken area shows that generating plants and substations escaped.

A large factor in preserving the plants and subs seems to have been the good housekeeping practices of the utilities concerned. Rights-of-way were kept cleared. So were the areas surrounding stations. Consequently, flames could be kept away from structures, without which the fastest reconstruction job on lines would be valueless.

These companies are to be congratulated on the careful operating practice which served them so well. The funds they spent on good housekeeping paid heavy interest in dollars, service and prestige. From their customers and all who pay tribute to the principle of good, dependable service, the Maine utilities rate a hearty "Well Done."

Instrument Transformer Impulse Levels

WITH the increase in system impulse levels in the 5 through 15-kv class, older, dry-type, instrument transformers are actually determining the system impulse levels. This problem hasn't appeared too acute, for while tests and experience indicate that lightning strokes are causing insulation flashovers, these are not necessarily followed by 60-cycle flashovers. In many cases, where there are power flashovers, damage is insufficient to prevent the system being restored to operation.

Partly because of this lack of indication, many operators have felt in the past that the old, low-instrument-transformer impulse levels were adequate since they caused little apparent trouble. Some even felt that if higher impulse levels required better-insulated but larger instrument transformers, a redesign to higher levels was not justified.

Now that there are new ASA standards for dry-type instrument transformers in this class, which are, in some cases, two or more levels above previous test values, it is well to re-examine lines where lightning is a problem. Instrument transformers built to the new standard have impulse levels as high as those of modern power and distribution transformers.

Some utilities did recognize this insulation coordination problem in the early 1930's. They bought instrument transformers in the next higher insulation level or with a higher low-frequency dielectric test as a step toward what they hoped would be materially higher system impulse levels. However, higher low-frequency dielectric tests do not insure corresponding increases in impulse levels. Impulse ratios for dry-type apparatus vary because of such factors as puncture, creep in air or a combination of both. The low-frequency test gives little indication of impulse strength.

Because of design, older, dry-type potential transformers in the 5 through 15-kv class test consistently about one insulation level lower in impulse strength than dry-type current transformers. Under the new standards, dielectric- and impulse-test voltages for both types of instrument transformers are the same.

Obsolete instrument transformers may be the cause of increasing numbers of outages due to lightning. These weak spots now can be eliminated with instrument transformers that have impulse levels equal to modern distribution and power transformers.

Stumbling Blocks

IN CHARITY, we must assume their intentions are good. At the same time, we may think of a place that is reported to be paved with good intentions. And perhaps we may be forgiven the wish, once in a while, that they would go there.

We have in mind those people who are responsible for the needlessly restrictive rules that appear, or are offered for inclusion, in some local electrical codes.

Every force in nature is dangerous if not controlled, if protection against it is not provided. Electricity is one of the more dangerous. For its safe handling in common applications, the National Electrical Code was set up. There are some who think the Code is unnecessarily restrictive in certain of its provisions. There are others who think it is not restrictive enough. This is a natural state of affairs. But the fact remains that the Code exists and is the expression of a large and representative body of informed opinion.

Those who quarrel with the Code on any point they think too restrictive still face a compulsion to conform to it. No such compulsion is on those who think it insufficiently restrictive in any respect. As individuals, the latter are free to go as far as they like to assure the safety of their own electrical installations. But the existence of the Code does put on them a compulsion to refrain from imposing their ideas on other people.

If a man believes his electric iron is not safe unless all its non-conducting metal parts are solidly grounded, he may have them grounded—and pay the cost of it. He is free, also, to preach his doctrine to any who will listen. But no one should have the right to take advantage of any position he may occupy to force other people to pay that additional cost on their electric irons. Not while there is a National Electrical Code that says an electric iron is safe without such grounding.

The effect in local codes of such arbitrary rules as this is to increase the cost of using electricity. Thus, its use is unwarrantably restricted. People are prevented from wide enjoyment of its benefits.

Here is a paradox. On the one hand is government exercising its regulatory function to force down the cost of electricity to the user. On the other hand is government exercising its police function to raise the cost of using electricity. The electrical industry is hampered in its progress by these stumbling blocks.

Out of the Mouths of Democrats

ONE of the first rules of politics is not to get very specific about an election a year before it is held. On that basis, we wouldn't dream of picking a winner now in next year's presidential campaign. But there is one qualified prediction which can be made in all safety. That is that on the basis of its record so far, the 80th Congress, a Republican-controlled body, will not have to worry about serious attack for having starved the Reclamation program.

If there ever was any worry, it was dispelled last week by the one man who should know best. That would be Reclamation Commissioner Michael W. Straus, who addressed the 16th Annual Convention of the National Reclamation Association at Phoenix. Said Straus:

"The past 12 months have witnessed the greatest volume of Reclamation work in the history of the West. . . . Congress, not only last year, but again this year, made the largest Reclamation appropriations in history."

The present appropriation, Straus said, "happens to be approximately double the average annual appropriation for the past 10 years," and he added:

"By any interpretation, Congress affirmed its appreciation, support and confidence in the West's reclamation program."

These and a lot more categorical comments made it unmistakable that the first session of the 80th Congress did not slaughter Reclamation. The prospect that it will do so in 1948 is pretty slim, really, for last year was the year of the economy mandate, the year in which no elections were scheduled at which vengeance could be taken if it were considered necessary. Whatever his motives, Straus has pretty well killed as a Democratic 1948 issue last Spring's uproar about GOP strangulation of Reclamation.

WASHINGTON COMMENT

W. B. WHICHARD

ONE of the most interesting developments of the 1946 Congressional elections has been the abandonment of their "crusading" attitudes by several federal administrative agencies. New Dealers by the score have left.

There has been a more subtle change at the Federal Power Commission. FPC promptly elected a new chairman after the GOP had captured control of Congress.

In comparison with some of his predecessors, FPC's new head is a rank conservative. Actually, his philosophy is probably that of a regulatory "professional," who prefers the "conference" method of settling issues, in contrast to the "damn the torpedoes" attitude of some earlier FPC chairmen. But the industries dealing with the Commission already have found that Chairman Smith fights as hard, and—to date, at least—as successfully, for what he considers the proper functions of his agency.

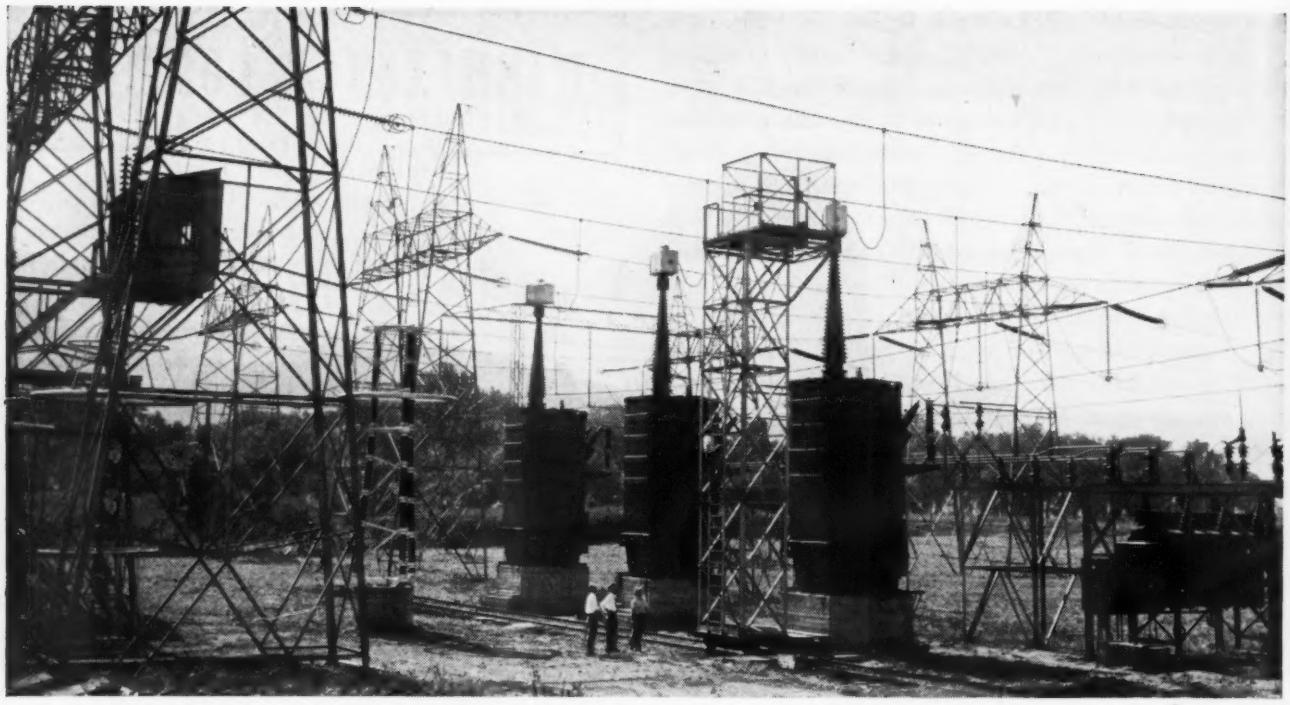
Last summer, for example, he led a Commission fight which stopped at least two serious attempts to revise the Federal Power Act. Principal issues of the Miller bills became obscured in the charges and counter-charges of "lobbying" and "propaganda" that were hurled back and forth during the House subcommittee hearings. The electric utility industry claimed the bills merely corrected over-zealous interpretations of the Act by the Commission, such as those upheld by the courts in the Hartford and Jersey Central cases, and others. The Commission said the bills would reestablish the "Attleboro gap."

All the old bitter suspicion that long existed between the Commission and the industry was renewed by the sensational "smear" charges which the newspapers gave such a play during the hearings. A compromise, for which the subcommittee asked, seemed impossible.

In the near future, however, industry groups are expected to confer with FPC on the Miller bills.

Apparently determined to carry on their fight for the Miller bills in the forthcoming Congressional session, the industry groups still seem in no mood for compromise. And they are likely to find FPC just as adamant.

It might be well for both sides to go into the conferences with a full awareness of the political realities of the situation. Facts for the industry are: (1) the Miller bills were stopped cold last year; (2) in an election year, of all times, the Congress certainly will proceed with caution on any legislation which stirs up as much unfavorable attention as these measures did last year. Facts for the Commission are: (1) some of its earlier interpretations of the Power Act, especially in the two cases mentioned, veered far from the letter and the intent of the law; (2) the present Congress is on record as opposed to what it frequently has called "loose" interpretation of its acts by administrative bodies.



500-KV SUBSTATION at field test laboratory. Left to right are: observation booth, tripod-type 350-kv lightning arrester, 5,000-kva high-voltage transformers with instrument housing atop bushings, and low-voltage circuit breaker

500-Kv Test Program Studies

ECONOMICS of transmitting ever-larger blocks of power points to the need for higher transmission voltages than those now used. But the cost of building these higher-voltage systems mounts rapidly as voltage is increased. Larger conductors are needed, also larger towers, higher insulation levels and more costly terminal equipment.

These hard economic facts, then, make it more than ever necessary to design high-voltage transmission systems so that the greatest use is made of their capabilities—in short, so that the very minimum proper margins of safety are achieved.

But, before extra-high-voltage transmission systems can be designed with these close margins, without sacrificing reliability, engineers need more basic information than is now available.

This, then, is the reason for the program of research in extra-high-voltage transmission that was launched on October 1 at Brilliant, Ohio, by power system engineers of the American Gas and Electric Co and an outstanding group of American electrical manufacturers. There they have built a full-scale high-voltage transmission system to study and evaluate problems of corona loss, power transmission ability, reliability and economics of transmitting power at voltages approaching 500 kv.

The scope and objectives of this cooperative research program, the facilities, arrangement and design of the apparatus installed at this laboratory, and the general pattern of the tests are examined in this article. It is based on a symposium comprising seven technical papers presented before AIEE at Chicago, November 3-7.

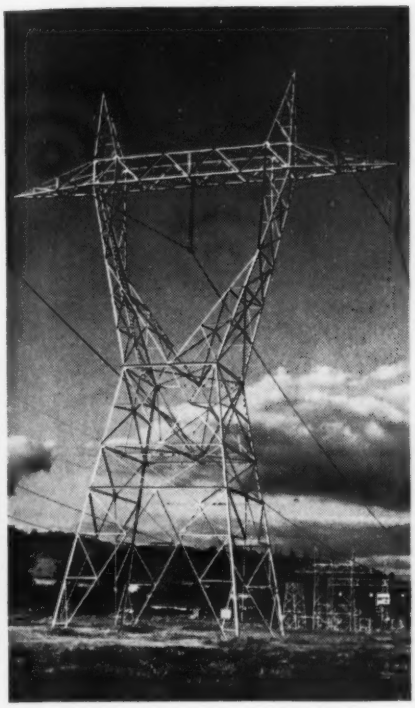
Insulation Level a Basic Consideration

Numerous factors have to be evaluated before reaching a decision to use a particular high voltage and before details of the design can be fixed. All of them will affect the economics of any proposed project. But the one single factor that will perhaps affect economics to the greatest degree is the insulation level adopted for terminal equipment and the insulation level and spacing for the line. The levels will naturally be influenced by the type of grounding that is ultimately adopted for the system.

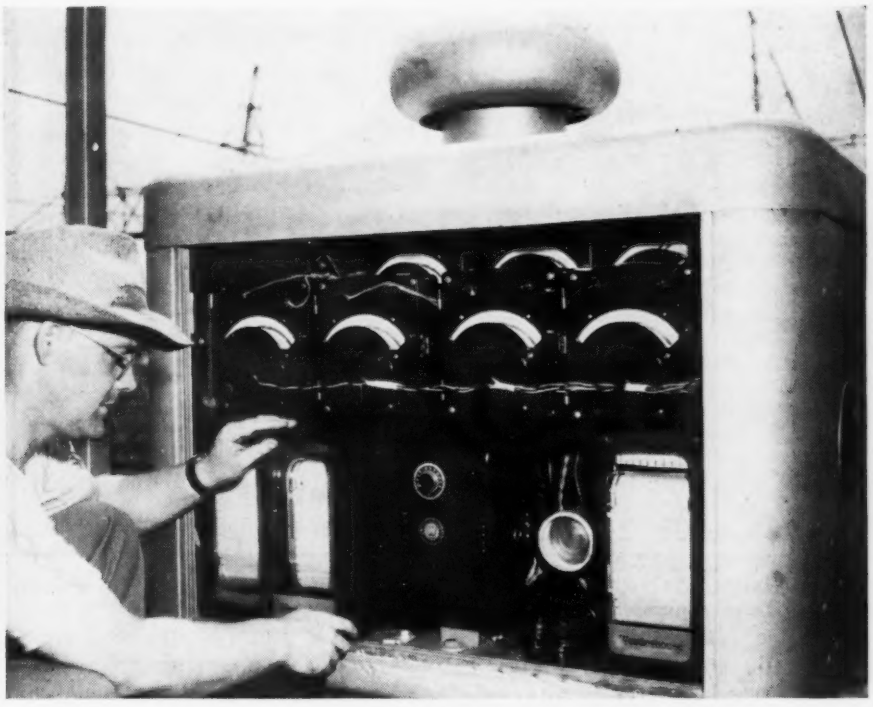
Solid Grounding

Authors of this cooperative research project believe that extra-high-voltage transmission systems, above 230 kv, must be permanently—and solidly—grounded at all transformation points. This will permit use of reduced-voltage arresters. Such solid grounding, when used with interrupting devices that will open the circuit with no more than a single restrike, will limit the magnitude of voltage in switching transients to which lines and equipment will be subjected. It will permit the use of lower levels of insulation than have been thought possible in any previous examination of the problem. This is particularly true of the inherently higher impulse value of the electrical equipment involved.

With this principle in mind the following series of basic insulation lev-



TANGENT TOWER for 500-kv test line. Maximum phase spacing is 45 ft



CORONA MEASURING EQUIPMENT in aluminum compartment on transformer bushing. Instruments will be read by telescope from remote observation booth

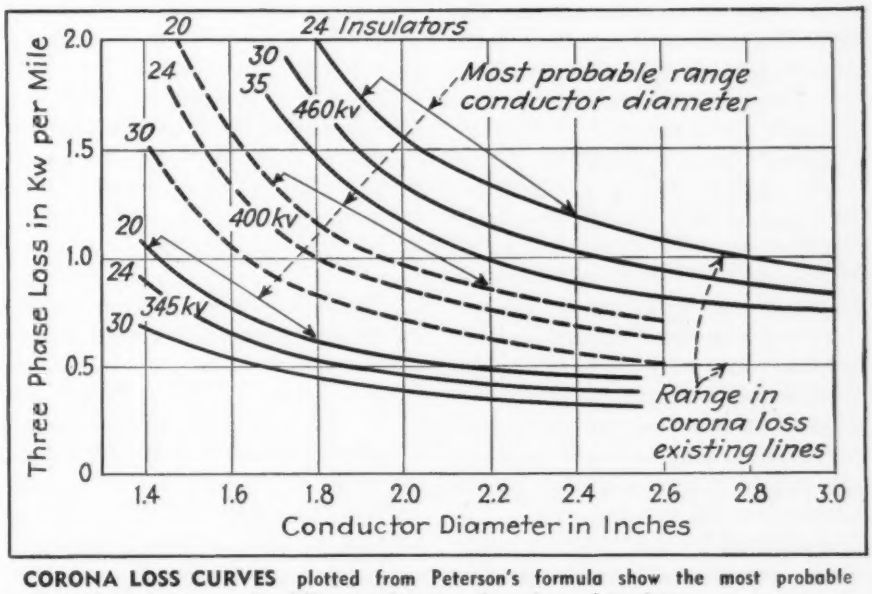
Higher Voltage Transmission

els for extra-high voltage equipment has been suggested:

Operating Voltage Kv	Basic Insulation Level Kv
230	950
287	1,050
345	1,200
402	1,400
460	1,550

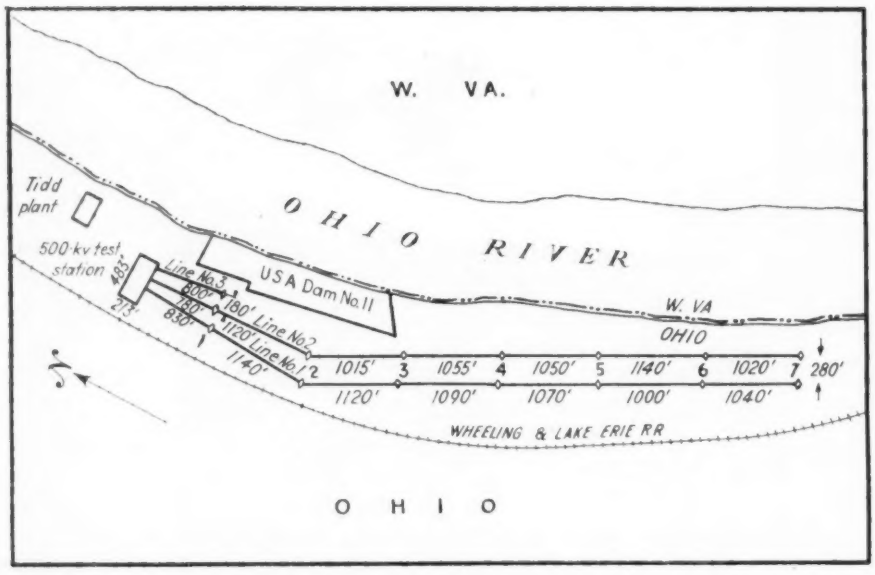
Considering the fact that modern high-voltage breakers are designed to have no more than one restrike, the maximum-line-to-ground switching surge voltage that would appear at a substation is about three times normal line-to-ground operating voltage for a solidly grounded system. Thus, as far as lightning and switching surges are concerned, the suggested insulation levels indicate that 20 insulators for 345 kv and 24 for 460 kv are *ample*. If these are the final controlling factors, the savings that can be made using the modified insulating level, rather than extrapolating present insulating levels, are so great that a major research effort is justified before they are given up.

Shorter insulator strings make smaller line spacings possible; smaller line spacings have the beneficial effect of reducing line capacitive and inductive reactance. Calculation shows that the increased power limit and charging kva obtained with smaller spacing is appreciable for a 200-mile line where line reactance angle is limited to 30 deg. Bundle conductors may offer greater savings through further decrease in line capacitive and inductive reactances.



CORONA LOSS CURVES plotted from Peterson's formula show the most probable range of conductor size for different voltages and numbers of insulators

However, disruptive corona voltage and corona power loss are very much affected by size of conductor and spacing. The greater the insulation



ARRANGEMENT OF TEST LINES near Tidd power station of Ohio Power Co at Brilliant, Ohio. This high-voltage laboratory is located about 35 miles from Pittsburgh

level of the line and the larger the spacing between conductors, the higher will be the disruptive corona voltage and the lower the corona power loss. As far as lightning and switching surges are concerned, 16 insulators with normal spacing for 345 kv would appear *adequate*. However, an abnormal conductor size might have to be used or else the corona loss would be too high. This may be the factor that would set the lower limit on dimensions of an extra-high-voltage line. Since this has a considerable effect on cost of a line, it too deserves and will receive critical study and research.

Before accepting the higher corona losses resulting from decreased conductor spacings or smaller conductor size it is considered desirable to get better data on several conductor sizes and spacings under service conditions, particularly under seasonal weather variations. The effects on corona of different atmospheric conditions, such as fair weather, cloud effects, rain, fog, sleet and snow and also electric ground gradients must be thoroughly investigated. Insulator loss affected by fog, sleet, rain and other atmospheric conditions must also be studied.

To obtain a basis for examining corona loss performance of various line constructions at the test station, a fair-weather corona loss calculation was made using Peterson's formula. These are based on a smooth conductor, 1,000-ft altitude, 25 C temperature and a surface factor of 0.9. The accompanying curve shows the calculated three-phase corona power loss per mile for three voltages (345, 402 and 460 kv) under consideration.

These curves show that if required conductor size was chosen for equal power loss for the different lengths of insulator strings at a given operating voltage, the range of conductor diameter would be considerable. Further study of the curves of the three voltage levels indicated that it would probably be impractical to limit the power loss to a constant value independent of operating voltage, if a level as low as 0.5 or 0.6 kw per mile is desired. It would call for an extremely large and impractical conductor.

Installation Description

The high-voltage field research laboratory where these problems will be studied, over the next three years, is located adjacent to the Ohio Power Co's Tidd power station at Brilliant, Ohio, about 35 miles from Pittsburgh. General arrangement of the high-voltage test lines and substation is shown.

Three test lines, like those used in practice, have been provided. Two of them are 1½ miles long. The third has a single 800-ft span. All three are connected directly to a bus at the test substation without circuit breakers. They are fed through a 5,000-kva bank of three single-phase transformers that step voltage up from a 69-kv supply to a line-to-line potential that can be adjusted in the range from 264,500 to 500,000 volts. The transformer bank is delta-connected on the 69-kv side and wye-connected and solidly grounded on the 500-kv side.

Three single-pole arresters of two different types have been installed to protect the transformers. A high-voltage impulse-type oil circuit breaker will be connected to the bus together with an arrester for its protection. Measuring instruments are mounted atop the transformer high-voltage bushing.

Bus work within the test substation is 2-in. hollow segmental copper conductor. Shielded measuring leads, enclosed within them, extend from the instrument housing atop transformer bushings to the entrance of the three test lines.

The substation is insulated with 26 5¾-in. spaced units while the lines use 26 to 30 units in suspension and double strings for dead ends. All insulators have a mechanical rating of 25,000 lb.

The two 1½-mile test lines have an average span of about 1,050 ft and comprise six towers each, two of which are dead-end structures. Lines run parallel and 288 ft apart. Conductors are 85 ft above ground to towers, 40 ft at mid-span. On all three lines provision is made for installing two ground wires at variable heights up to 40 ft above phase conductors. These ground wires extend over the station for bus and equipment shielding.

Steel towers support the conductors. Crossarm elevation is 100 ft above ground. Ground wires are located 24 ft above tower crossarms which are 90 ft long. Attachments on the crossarms allow outer conductors to be moved toward the center of the tower, thus providing alternate phase spacings of 45, 38½ and 32 ft. Ground wire peaks also have alternate attachment points so that ground conductors can be lowered 6 ft or 12 ft below the normal topmost position.

Experimental Conductors

Four types of conductors will be tested on experimental lines: (1) hollow segmental copper conductors, (2) hollow stranded copper conductors with an I-beam core, (3) ACSR conductor with paper filler between

steel strands and outer aluminum strands, and (4) "bundle" or grouped conductors consisting of 2, 3 and 4 hollow-stranded copper conductors in parallel per phase.

Several factors entered into selection and installation of these conductors for corona determination on the test project. These included conductor conductance, diameter, surface contour, spacing and material.

A figure of 650,000 cir mil copper equivalent was selected as a lower value which was believed would handle foreseeable needs of transmission above present high-voltage levels.

Conductor outside diameters ranging from 1.4 to 2.0 in. were chosen. In addition to conductors of 1.65 and 2.0 in. OD, a 1.4-in. segmental copper conductor will be tested to check existing data on corona dry-weather characteristics gathered at the time the 287-kv Boulder Dam line was built.

The 2.0-in. OD conductor size was about the largest that it was considered feasible to make, install and operate. Corona data on the 1.4, 1.65 and 2.0-in. OD conductors will give the necessary correlation for any intermediate sizes that might be used in practice.

In addition to these single-conductors, so-called "bundle" conductors will be tested. These will be made up of groups of individual conductors ranging in size from 0.70 to 0.92 in. OD with from two to four conductors per phase group.

Three sizes of the type HH segmental copper conductors are to be supplied for use on the test lines: (1) 1.65-in. OD, 650,000-cir mil cable for one of the 1½-mile test lines, (2) 2.0-in., 1,030,000-cir mil cable for substation bus work where instrument leads must be shielded between transformers and lines, (3) 1.4-in. OD, 512,000-cir mil cable, identical with that on the 287-kv Boulder Dam line, for the single-span test line.

Two sizes of "expanded" ACSR conductor will be supplied for the test lines. These are identified as 1,062,-800-cir mil expanded ACSR having a diameter of 1.65 in. OD and 991,-500-cir mil expanded ACSR cable having a 2 in. OD. The first-named cable is quite normal in construction except for the radial space occupied by filler strands of impregnated paper. The 2-in. cable includes a new feature, the wrapping of aluminum foil tape just under the single layer of aluminum strands.

Three sizes of stranded hollow copper conductor with I-beam core are also provided. The largest of these is 1.65 in. OD and will be used for single-phase conductors.

The two smaller sizes, 0.7 and 0.92 in. OD, will be used for tests of "bundle" conductors to provide data regarding the effect of: (1) 2 vs 3 vs 4 conductors per phase, (2) corner radii, ie, individual conductor diameter, (3) interaxial spacing of individual conductors in the group.

Insulators and Hardware

Insulators selected for the Tidd test lines are 5¾-in. spaced standard 10-in. suspension units. From the electrical characteristics of these insulators and the ratio of insulator flashover to line-to-ground voltage for a 500-kv line, it was concluded that no more than 30 units would be needed for test feasibility on the three-phase 500-kv lines and 26 insulators would suffice for the substation bus.

Since conductors as large as 2 in. were planned, the maximum design conductor tension under 8-lb wind loading and ½-in. ice was 15,000 lb. For economic reasons dead-end insulator assemblies were restricted to two strings of insulators. This led to the use of insulators with a rated strength of 25,000 lb. Maximum vertical loading of conductors at suspension points was 6,600 lb. Single strings of 25,000-lb insulators were selected of the same type used as strain positions. On the substation structure where 2-in. segmental copper conductor was strung to a loaded tension of about 11,000 lb, single strings of 25,000-lb insulators were used.

Special line hardware had to be developed for the three conductor sizes used (1.4, 1.65 and 2.0 in. OD). Line suspension and dead-end clamps were specially designed for all 1.65- and 2.0-in. copper conductors. A standard clamp was used on the aluminum 2.0-in. ACSR cable. Special line hardware was also provided for the "bundle" conductors.

Extensive laboratory tests indicated need for shielding on the line-end of insulator strings for two reasons: (1) To grade the insulator string, and (2) to control the electrostatic field around the line hardware in the vicinity of bolts, nuts, clamps, washers, etc. However, no grading shield was required at the upper end of the string or at intermediate points on the insulator assembly. Shielding rings of several designs were supplied using 1.9- and 2.0-in. OD pipe.

Participating Manufacturers

Cooperating with American Gas & Electric Co is an outstanding group of electrical manufacturers. Westinghouse Electric Corp contributed the power transformers, lightning arresters, and measuring equipment. The American Bridge Co contributed towers for the field laboratory, and Ohio Brass Co and Locke Insulator Corp donated insulators and hardware. The Aluminum Co of America, General Cable Corp, and Anaconda Wire & Cable Co supplied the conductors. General Electric Co is supplying an oil circuit breaker and arrester.

Transformers and Lightning Arresters

Transformers that supply the high voltage for the test lines were built according to design principles that apply to commercial high-voltage transformers. The single-phase units are wye-connected on the high-voltage side and have the neutral solidly grounded. Although the rating of 1,667 kva (5,000-kva bank) is below that which would be economical for extra-high voltages, it was desirable to use essentially the same design methods that would be used on 75,-000 kva to get operating experience.

Tap changers provide voltages from 265 kv to 500 kv. This range is secured by using a standard 10 percent tap range on the high-voltage winding and a larger range of taps on the low-side winding. These taps are brought out to no-load tap changers on the tank wall. Total tap range is covered by 24 steps. The low-voltage tap changer provides large steps with the high-voltage tap changer acting as a vernier.

Lightning arresters are installed adjacent to the transformers in the test station. They use the same standard units or sections used in auto-valve station type arresters of all

(Continued on page 178)

Rewinning the Campus:

Prerequisites to Successful Recruiting

ARCHER E. KNOWLTON
Senior Associate Editor
Electrical World

The industry needs new plant—and is getting it . . . It needs new men to operate that plant and to complete the vast expansion which is ahead . . . Here are some ways of insuring that the industry gets the men it needs

ELECTRIC UTILITIES aren't doing anywhere near enough recruiting. Some, apparently, are doing none.

This fact constitutes one of the most startling aspects of the industry's whole trained-manpower problem. Existence of this problem has been overshadowed for some years by the tremendous war job which faced the industry and by the even greater job which has faced the industry since fighting stopped—that of getting plant installed and systems strengthened and expanded to handle the skyrocketing loads. But the expansion problem with which the industry now wrestles only aggravates the manpower problem.

Doing so little recruiting at the nation's colleges is a serious indictment of an industry destined to expand by at least a third in the next five years. It is even more serious if one credits the projections of President Elmer L. Lindseth, of the Cleveland Electric Illuminating Co. In his Edison Electric Institute paper at Atlantic City last June, Lindseth pointed to the possibility that the industry may be five times its present size—in plant, output, and revenue—in another 30 years.

Whether he overshot the mark or fell short of it, Lindseth projected in stunning relief the industry's manpower problem.

Recently, ELECTRICAL WORLD presented some of Lindseth's supporting data (ELECTRICAL WORLD, October 11, 1947, Page 103) indicating that engineering students and the men who train them have cooled off on the electric utility industry as a place in which to build a successful career. Both in the tabulated returns to a Lindseth questionnaire and in letters which faculty men wrote, there was stark evidence of this trend.

The Lindseth findings, the heavy system growth, and other factors have combined to make the industry aware of its manpower problem. Doing something about it will be something else again. However difficult it may prove, the job was done before—during the expansion period of the 1920's. Then, the industry recruited actively among the yearly graduating classes of the nation's technical schools. Utility "scouts," personnel men who visited the campus in search of young, trained manpower, signed the cream of the crop. Competitors got their share, of course, but the electric utility career was one which appealed to the best men available. Support and assistance of faculty members, of course, contributed to this effective recruiting.

All this has changed. Termination of the industry's expansion, during the depression, halted the recruiting of cadets. The political assault of the latter 1930's tarnished the industry's attractiveness. The war got first call on young men. New developments in the art — primarily electronics — brought new competition for men into the field. Existing competitors—notably the electrical manufacturers—expanded and required more men than ever before.

All these factors will have to be remedied if the electric utility industry shall be able to regain its standing on the campus. This reversal won't be easy to accomplish. First step in the job will be to see what must be done. Table I will help:

Table I—Sizing Up the Job

1. Analyze your personnel structure as an actuary would in projecting "mortality experience."

2. How many "top-third" replacements will you need over 15 years?

3. Besides age or disability, what loses your men between cadet and executive?

4. Why did your veterans fail to return to the company?

The unprecedented enrollment in U. S. colleges and universities will, one day, pour out a flood of highly trained men. Already it is beginning to do so. But under present conditions, the flood is not one of job seekers but of jobs. Thus, the electric utility industry must buy in a seller's market, and must adapt itself to such a market. Being faced with a necessity to cultivate young men who are somewhat disaffected regarding the

power business—and buy them at a time when many others seek them—the utility industry has a double job on its hands. Youth psychology, a luxury in times of depression, may well be a must today. In Table II are several points which will help cultivate youth's opinion of the electric utility industry as a place to build a career.

Table II—How Youth Thinks

1. Must public opinion be remolded to re-attract the educational community?

2. Check again the assertion by some educators that students generally are unenthusiastic about electric utility employment.

3. What factors have caused this, if it be true?

4. Compare utility employment with civil service. Which is more attractive?

5. Resume the tours of power plants and major substations which once were common for high school classes.

6. Set up public displays of power system equipment and operation. (See "Duquesne Light Shows Pittsburghers How Electricity Is Supplied to Them," ELECTRICAL WORLD, August 31, 1946.)

When the industry has determined what its trained manpower needs are likely to be, it will have to re-examine the conditions under which men consider and accept employment in one location rather than in another. Those who have shunned the campus for the greater part of a generation will find that the thinking of students and faculty members alike has changed remarkably. No one knows better than utility management what has happened to the value of the dollar. This should make it readily understandable why a salary scale which commanded the best recruits 20 years ago is one likely to be sneered at today. Again, no one knows better than the utility man that parts of two generations—and all of the young men almost without exception—have fought a war. Precisely how they differ from the engineering graduates of 20 years ago would be difficult to say. But most of them are older. Many of them, particularly the college men, have held positions of considerable authority under conditions of considerable stress. Such men may be reluctant to start so low or progress so modestly as utility practice often has dictated.

These and other changes will affect the electric utility industry's return to the campus. To help master them, determine where your system stands on the points in Table III.

Table III—Times Have Changed

1. Twenty-five years ago, top qualified students habitually chose electric utility employment. Today, few do, even of the mediocre group. Why is this true?

2. Is it true of your system, as faculties and students seem to believe, that salaries depend on arbitrary grading and seniority rather than on merit and productivity?

3. Do you want men who seek primarily security or those who seek primarily opportunity?

4. Compare your salaries, at all levels, with those of your competitors for technical recruits.

5. Why do "more men from utilities than all other industries combined" return to college placement bureaus seeking a transfer of employment?

6. What would you do to dispel the idea that "utilities hire a man and then forget him for ten years?"

In the great hunt for young, capable, trained manpower which is engrossing American industry today, the campus is dominant. It seems obvious that the engineering-recruit seeker who stands high with the men who control the campus—the faculty—will have a superior chance of meeting his needs. It is the faculty member who trains the young men, who knows their capabilities, their desires, and how they may best be stimulated. To ascertain how your system stands with the faculty, consider the points in Table IV.

Table IV—Winning Standing on the Campus

1. Give faculties literature about your business which they may use among students.

2. Establish scholarships and fellowships—or haven't you any problems which merit advance study?

3. Set up cooperative research programs which employ graduate students.

4. How would you rekindle faculty interest in the 60-cycle power field?

5. Use engineering educators on research in collaboration with your engineers.

6. Could faculty members handle refresher and advancement courses for your employees?

7. Have professors and instructors help your engineers study for their professional licenses.

8. Invite faculty men to your technical meetings to broaden their "feel" of the field.

Recruiting should begin as soon as the student enters college. Only the final interviewing and negotiations should be deferred to the senior year. Efforts should be made in freshman, sophomore and junior years to inform the prospects. Otherwise, the major courses will have been chosen and the student grooved into alien channels.

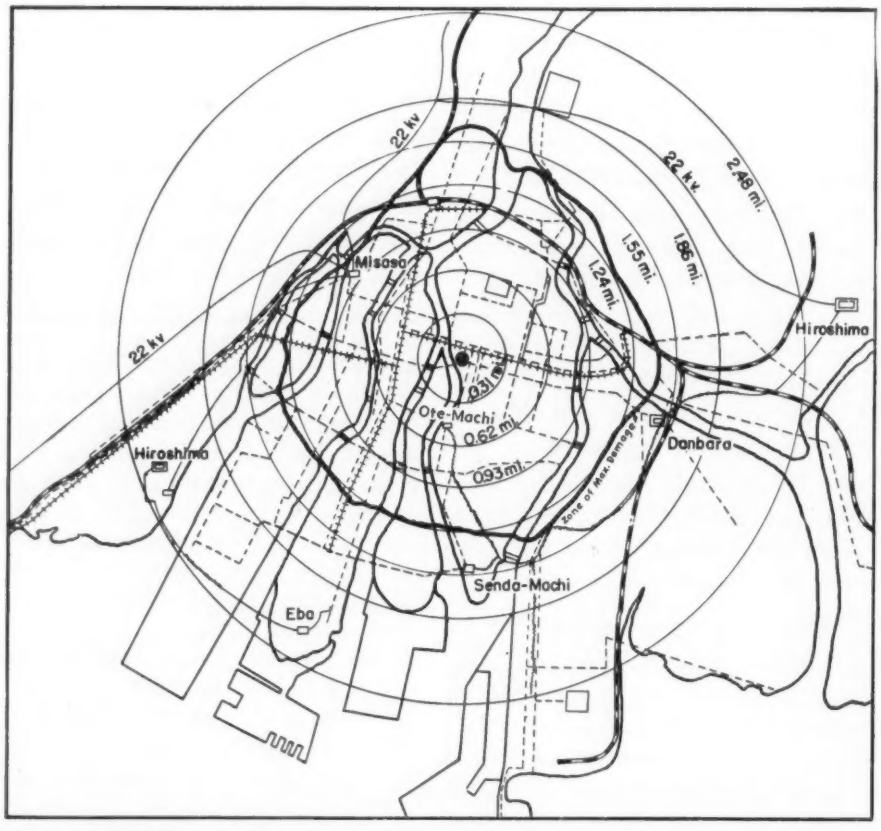
One medium for establishing and maintaining contact with the under graduate is through the relation of the local sections and the student branches of the AIEE. Utility engineers who are AIEE members should take interest in the nearby branches

(Continued on page 180)

BROKEN POLES numbered about 10 percent of the total in the zone between 3,300 and 6,500 ft from bomb center. About 70 percent of these broke at the base, like this at 4,000 ft from bomb center. Heaviest pole damage, about 30 percent, was in zone between 300 and 3,000 ft from bomb center

NEAR BOMB CENTER only 10 percent of poles were seriously damaged by bomb force which bore down vertically. This pole was 2,000 ft from the blast

Japanese Appraisal of Atomic Bomb



MAP OF HIROSHIMA showing zone of major bomb damage in relation to key points on the system of the Chugoku Electric Supply Co Ltd

Data for this article was obtained by the authors while serving as consultants to the Secretary of War on a mission to Japan.

R. M. VAN DUZER, Jr
Chief Operating Engineer of Power Plants
The Detroit Edison Co
and
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Vice-President
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IF a Hiroshima-class atomic bomb were to be dropped on a modern American city, the damage to the city's electric supply system would be far less extensive than that done to the system of the Chugoku Electric Supply Co Ltd on August 6, 1945.

There would be widespread destruction, of course. But underground transmission and distribution systems would be spared. Modern fireproof building construction would prevent fire following the explosion

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BLAST FORCE canted poles (left) in lines perpendicular to the blast at 3,280 ft but left others (center) plumb that were in lines parallel with the blast. Note hanging transformers. Damage to pole-top transformers was extensive within a mile of the blast. Most of it was caused by fire and jarring units from poles

AT BLAST CENTER this steel pole remained undamaged since the force was exerted on it almost vertically. However, wires and crossarms were damaged

Damage to Hiroshima Utility System

Evaluation of damage to electric utility system of Chugoku Electric Supply Co at Hiroshima by Japanese engineers relates damage to various system components to distance from bomb explosion . . . Overhead lines heavily damaged; wood and steel poles worst hit; reinforced concrete poles and structures stand up well . . . Fire causes bulk of damage

from spreading to adjacent wood poles. And, except within a mile of the blast center, the reinforced concrete and heavy brick construction of American-designed substations and generating stations would stand them in good stead. Fire, rather than bomb blast or heat radiation, would probably create the greatest havoc.

These conclusions are supported by a report of Japanese utility engineers. These men examined the wreckage of the Hiroshima electric utility system after the smoke had cleared away.

In brief, they found that:

1. Radioactive substances did no damage to the electric facilities of the utility system.

2. Underground cable systems were undamaged, except at terminals.

3. Bulk of the damage to wood pole distribution lines was caused by fire that, in the majority of cases, communicated from adjacent inflammable buildings.

4. Latticework steel poles were particularly vulnerable to damage at distances up to 6,000 ft from the bomb center.

5. Reinforced concrete poles survived the blast best of all.

6. Distribution conductors in the smaller sizes were cut, broken or burned up to a mile and a half from the blast. Larger sizes suffered the least damage.

STEEL POLES FAILED at 6,000 ft from blast but nearby concrete poles visible in the background stayed up undamaged

7. Only 10 percent of the line insulators were damaged by the bomb blast. There was no damage by bomb force beyond a mile. Bulk of insulator damage inside a mile radius

LATTICE WORK POLES bent 3 to 6 ft above ground when blast force was in direction of line (left) but somewhat higher—3 to 12 ft—when blast was perpendicular to line. These steel poles were 3,280 ft from blast center. Few steel poles failed at the base

CONCRETE POLES stood the blast in all but one case out of 24. This one was only 650 ft from the bomb center

was by fire and failure of supports.

8. Damage to pole-top transformers and switches was extensive within a mile from the blast. Most of it was caused by fire and jarring of units from poles.

9. Fire caused the major damage to plants and substations. These, in many cases, had wooden roofs.

10. Brick and reinforced concrete plant structures a mile or more from the blast stood up well. The interior was burned out in most instances because of wooden roof construction. A brick substation 500 ft from the bomb center was completely demolished.

In general, destruction caused by the atomic bombing at Hiroshima was complete. It has been estimated that 60,000 people were killed by the fire, bomb blast, and radioactive contamination.

All buildings within 6,500 ft of the bomb explosion were destroyed or burned out. Most of these were of wood construction. Those between 6,500 and 10,000 ft were half-destroyed; even strongly constructed buildings of reinforced concrete in this zone were destroyed except for outer walls.

The utility company's five-story reinforced concrete office building, located within a half-mile of the bomb center, was completely burned out. Of the 340 employees, 34 were killed immediately, 44 died of injuries, and 78 were seriously injured.

The building itself was not completely destroyed. The reinforced concrete construction of the walls, ceilings and roof prevented total collapse. Thus, it was possible to make temporary repairs and reoccupy the building at a later date.

Damage to Supply Lines

Electric supply lines were totally destroyed by the bomb blast and the fire that followed. From observations, the Japanese engineers estimate that the bomb detonated at an altitude of 1,700 ft over the center of the city. The point of explosion is indicated on the accompanying map.

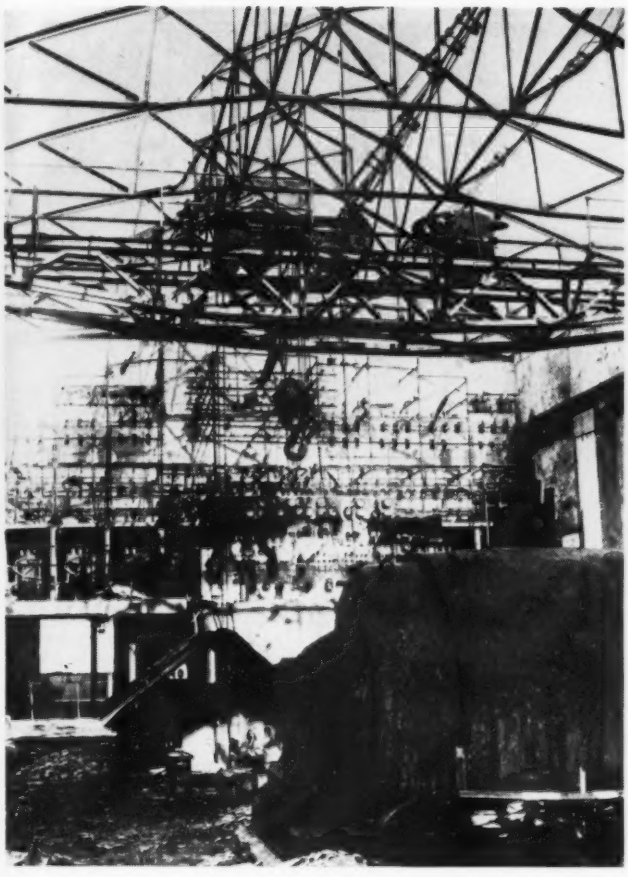
The effect of the bomb explosion itself on power line structures varied. Wooden poles were entirely burned down. Iron and steel poles were destroyed through structural collapse. Only reinforced concrete poles survived, comparatively undamaged. But the number of these in existence was too small to be of much significance.

Wood Pole Lines

The major damage to wood poles was caused by the spreading fire that followed the bomb explosion. The radiation of heat from the bomb and

TABLE I—Summary of Damage to Wood Poles

Distance	No Damage	Inclined	Broken	Knocked Down	Half Burned	Burned	Total
0–1,650	6	5	18	5	4	231	269
1,650–3,300	33	26	37	3	3	550	652
3,300–5,000	182	29	20	0	13	883	1,121
5,000–6,600	347	15	5	6	17	743	1,133
6,600–8,200	1,006	0	0	0	4	41	1,051
Total	1,574	75	80	14	41	2,448	4,226



OTE-MACHI SUBSTATION, a steel-frame mortar-lined building 2,500 ft from blast center (above), had its walls blown in, leaving only the framework. Outside steel work collapsed. Fire burned out the interior, destroying panels and transformers

FIRE AT SENDA-MACHI STATION following the bomb destroyed machines and switchboards completely (left)

the force of the bomb blast did relatively little damage to the wood poles. But, since virtually all wood poles were burned down, it was extremely difficult for observers to determine the damage effects of the bomb force and the concurrent heat radiation.

Effects of heat radiation varied with the distance from the center of the explosion. However, poles near the bomb center were an exception. They were only slightly damaged by heat radiation, since it came down almost vertically.

Between 10 and 20 percent of the poles between 1,650 and 5,000 ft from the blast center were harmed by heat radiation. Many poles were not damaged although they were the same distance away. Observers credit this to the quality of the poles and the degree of heat. From 5,000 to 8,200 ft, poles were superficially burned by heat radiation to a depth of 1 to 3 mm. Beyond 8,200 ft, poles escaped damage from heat radiation.

Similarly, the force of the bomb explosion did relatively little harm. About 10 percent of poles 330 ft from the blast were slightly damaged, this because the bomb force was exerted vertically. Poles from 300 to 3,000 ft were heavily damaged in about 30 percent of the cases while from 3,300 to 6,600 ft, about 10 percent were either broken or felled. Many poles were canted because of wire breaks. Beyond 6,600 ft, relatively few poles were leaning. Observers believe that at a mile the force of the blast was almost identical with typhoon wind pressures. About 70 percent of poles that were broken or felled failed at the foot; 20 percent failed 6 to 10 ft above ground.

Fire damage was extensive. Practically all poles 15 ft from buildings and houses were burned, regardless of their distance from the bomb center. The degree of fire damage to the wood poles varied with wind direction, type of adjacent buildings and distance from buildings, as might be expected.

TABLE II—Summary of Damage to Steel Poles

Distance	No Damage	Leaning	Broken	Total
0-1,650	1	0	8	9
1,650-3,300	1	1	30	32
3,300-5,000	0	0	2	2
5,000-6,600	18	0	19	37
6,600-8,200	0	0	0	0
Total	20	1	59	80

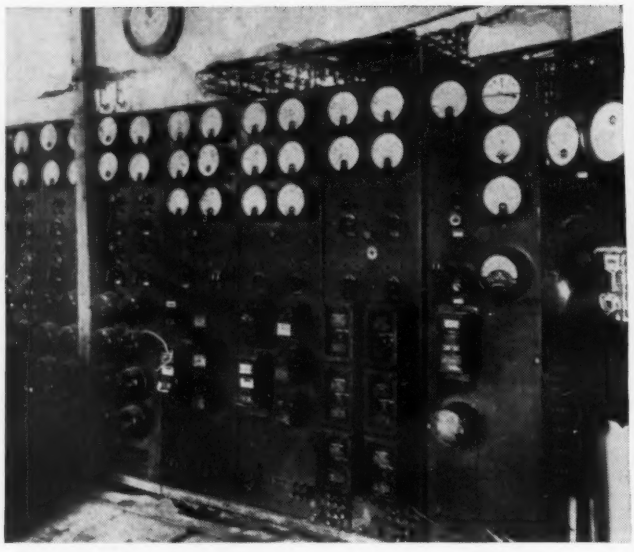
TABLE III—Summary of Damage to Concrete Poles

Distance	No Damage	Leaning	Broken	Total
0-1,650	1	0	1	2
1,650-3,300	0	0	0	0
3,300-5,000	3	0	0	3
5,000-6,600	19	0	0	19
6,600-8,200	0	0	0	0
Total	23	0	1	24

Steel Poles

The number of steel poles in Hiroshima was only about 2 percent of the wooden poles. But, 75 percent of these failed under the force of the blast within 6,600 ft of the center of explosion. Three steel poles near the bomb center were entirely undamaged because they were apparently hit vertically by the blast. About 95 percent of the steel poles in the 660- to 3,300-ft zone were completely damaged. At 6,600 ft, poles were seriously but not totally damaged. The safety zone for steel poles was beyond 8,000 ft.

At a distance of 3,300 to 6,600 ft,



DAMAGED INSTRUMENT PANEL at Mishino substation 5,250 ft from bomb center. Wooden roof and windows in this brick building were damaged. Transformers and switches were undamaged, returned to service

WRECKAGE OF YAGURASHITA substation 650 ft from bomb center. The brick building housed converters and mercury arc rectifiers for the local trolley system. The building was destroyed and completely burned out

steel poles on the Ote-machi main line were extensively damaged while concrete poles nearby remained unscathed. Steel poles hit by the blast parallel to the line were bent over 3 to 6 ft from the ground; those hit at right angles to the line failed 3 to 12 ft from the ground. Bolt holes in the framework were the weak points.

Concrete Poles

Damage to the 24 reinforced concrete poles on the system was very slight. At 660 ft, one of two concrete poles was undamaged except for a small crack. The other was destroyed. At 6,000 ft, all six poles were undamaged. There were no concrete poles in the range from 1,650 to 3,960 ft. However, chimneys in this zone were not affected and it is reasonable to conclude that concrete poles would have escaped too.

Wires

Fire caused the bulk of the damage to line conductors. Here too, damage decreased with distance from the explosion. There was no damage beyond 10,000 ft. In the vicinity of the blast, however, wires 3.2 to 4 mm in diameter were down but those larger than 5 mm were undamaged.

Insulators

Between 50 and 60 percent of line insulators were destroyed by fire; 20 to 30 percent because of failure of supports. Insulators directly damaged by explosive force totaled 10 percent. Little or no damage was caused by heat radiation. But fire caused the sulphur and cement bonds to become ineffective. Many insulators, although partly damaged, were still capable of being used.

Some insulators whose caps were carried away by the blast remained on poles, either standing or leaning, at a distance of 3,300 ft. Beyond 5,000 ft, there was no damage by bomb force. Insulators that were damaged at this distance were lost through destruction of supports.

Pole-Top Transformers and Switches

Blast effects and fire damage accounted for most of the pole-top transformers and oil switches destroyed. Fire contributed to about 90 percent of this destruction. Many were damaged in falling from the pole when supports burned away. Within 3,300 ft, many transformers and switches fell or were dislodged. Beyond 5,000 ft there was no damage.

Underground HV Cable

Underground cables, buried 2 to 4 ft deep, escaped virtually unharmed. But some were damaged at terminals or at connection boxes by the blast or fire from buildings. In these cases, insulating compound and lead sheaths were melted and insulating paper burned. At the company offices, several yards of cable were burned but these sections have been repaired and the cable is now in service.

Damage to power stations was chiefly from destruction of buildings by bomb blast and damage to ma-

TABLE IV—Equipment at Senda-machi Steam Plant

Prime Mover	Kva Capacity	Boiler Type	Boiler Units	Turbines Type	Turbines Rpm	Generator Kw Capacity	Generator Voltage	Transformers Units	Transformers Kva Capacity	Transformers Phase	Transformers Voltage	Transformers Units
Steam	6,000	Hiene	6	Mixed Steam Turbine	3,600	3,000	3.3 kv	2	1,500	1	22–11/3.3	4

TABLE V — Equipment at Damaged Substations

Name	Kva	Kva Capacity	Phase	Kv	Units
Ote-machi	6,000	2,000	1	22–11/313	3
Mishino	6,000	1,000	1	22–11/3.3	7
Danhava	6,000	1,000	1	22–11/3.3	7
Nambu	6,000	1,000	1	22–11/3.3	7
Enami	6,000	2,000	1	22–11/3.3	3
Kago	3,000	1,000	1	22–11/3.3	3

chines and furnishings by fire.

Most heavily damaged stations and substations were the Senda-machi power station and the Ote-machi substation. These were 8,000 and 2,500 ft from the bomb center respectively. Nambu, Enami and Kogo substations were slightly damaged. Equipment at each of these stations is listed in the accompanying tables.

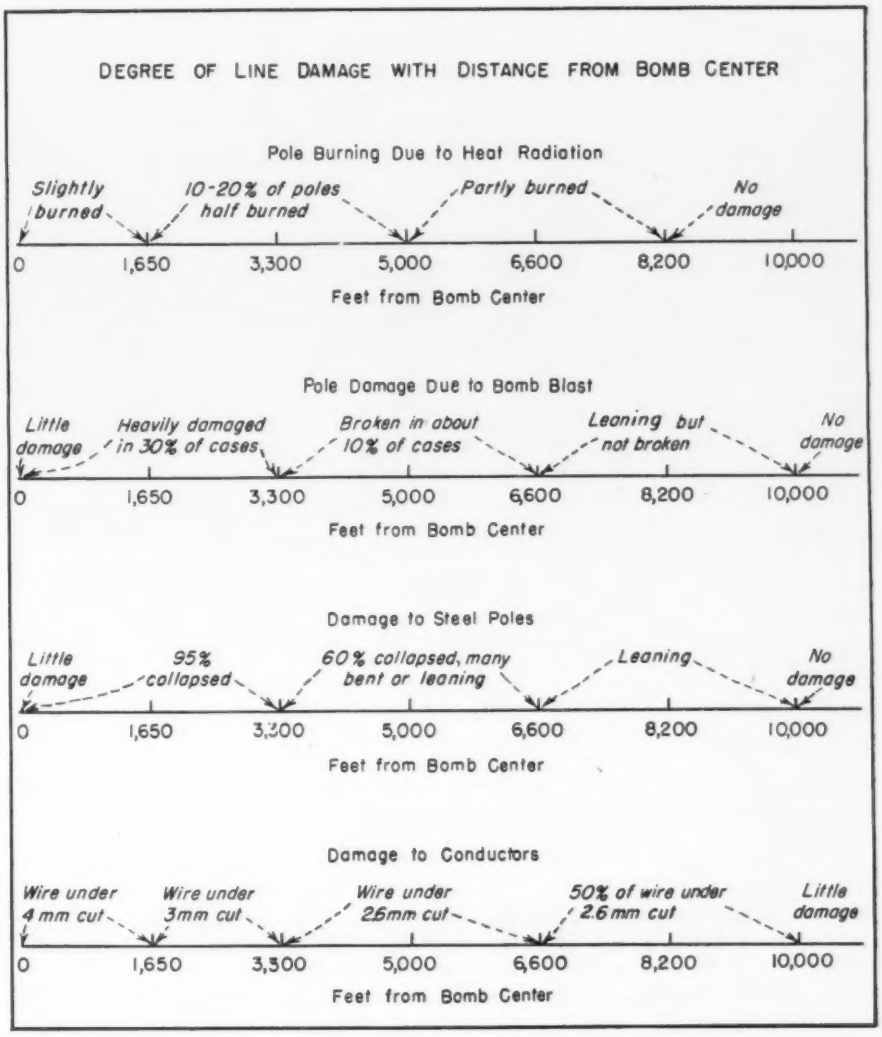
SENDA-MACHI STATION—Machinery and equipment at this steam station were largely obsolete. It had not been used for several years, and was slated for razing. At the time of the bombing it was used only as a distribution substation.

The bombing and subsequent fire destroyed all the buildings and equipment at this plant. The extent to which boilers and generators were damaged is still unknown but observers believe they can be repaired.

OTE-MACHI SUBSTATION—Electricity had been supplied from Ote-machi substation until June, 1945, when operation was discontinued in order to evacuate. The substation building was a three-story, steel-frame, mortar-lined structure. The power transformers were located outdoors. Under the blast, the building walls collapsed, leaving only the steel framework. Steel structures outside the building collapsed. The station caught fire from adjacent fires. Switch panels were burned out. Oil transformers burned or were knocked over by the blast. Only the main transformers can be re-used.

MISHINO SUBSTATION—Switch panels and high-tension transfer switches were housed at this brick substation 5,300 ft from the bomb center. Other special high-tension change-over switches and transformers were located outside the building. These were not burned out. The roof and windows were damaged, the switch panel collapsed, and instruments were bent in about 5 cm. However, transformers and switches were not damaged. With temporary repairs, this station has been in operation since the end of the war.

DAMBARA SUBSTATION—This building has a reinforced concrete wall structure with wood and tile roofing. It is located 8,000 ft from the blast center. Like the Mishino substation, there were switch panel and high-tension transfer switches in the building; special high-tension change-over switches and transformers outside. Damage was slight because the station was not burned out. The wooden roof, windows, panel and instruments were damaged. But high-tension facilities escaped serious damage. The station has been in operation since August 8, 1945.



DIAGRAMS RELATE the nature and degree of line damage with distance from bomb center. Note comparative pole damage

NAMBU, ENAMI AND KAGO SUBSTATIONS—These stations, located 13,000 to 15,000 ft from bomb center, suffered only slight damage. Nambu station, built of reinforced concrete, had only window glass broken. Electric facilities and instruments were undamaged.

Enami and Kago stations, built of wood with slate roofing, had ceilings and windows broken. The Kago building inclined about 10 deg. Several insulators were broken and one relay was damaged at Enami station, and several batteries were broken at Kago station.

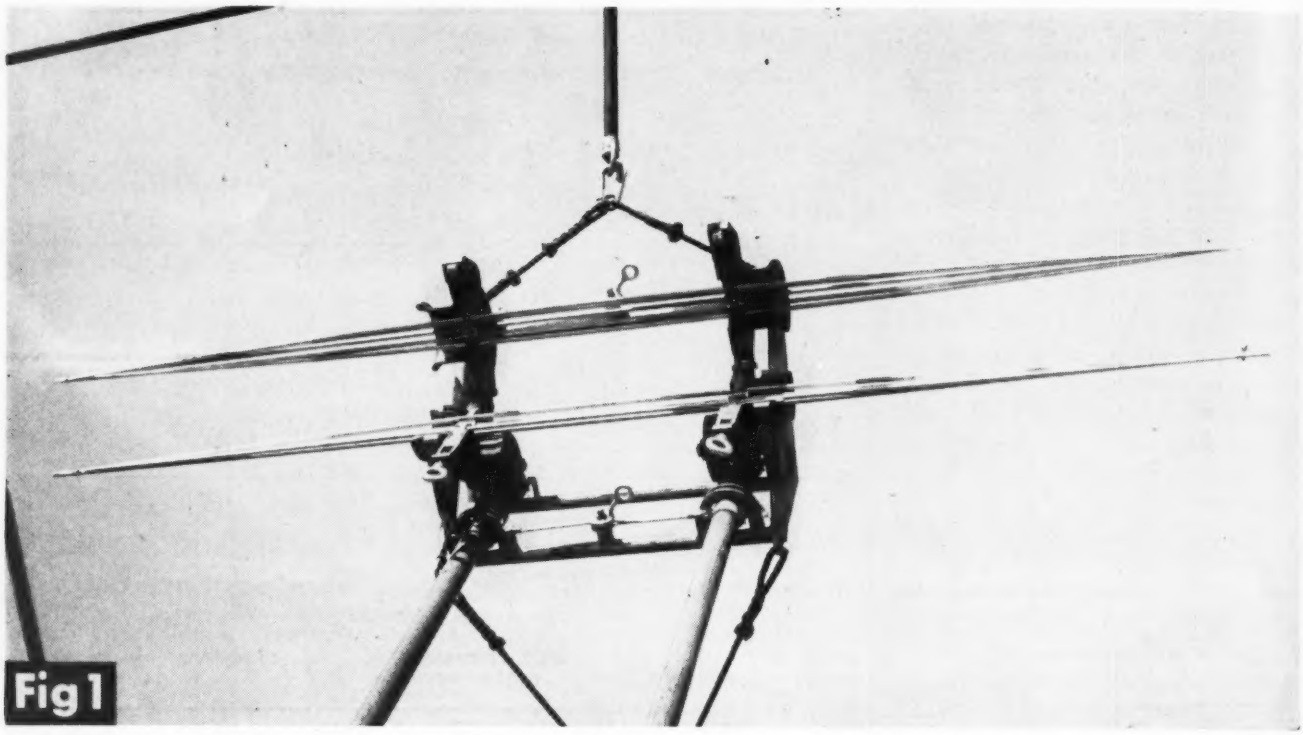
YAGURASHITA SUBSTATION—This station supplied power to the local trolley system and was located only 650 ft from the bomb center. It was equipped with mercury arc rectifiers and rotary converters. The brick building was destroyed and completely burned out.

Transmission Lines

Both overhead and underground transmission lines escaped damage almost entirely because of their distance from the bomb center.

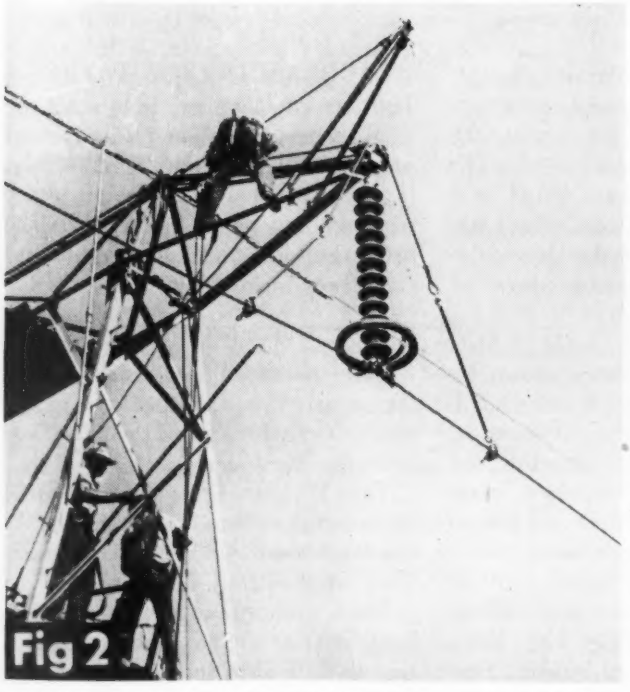
The Mishino line and Miyauchi lines, both overhead, were nearest to the explosion center, at 6,600 ft. They were entirely undamaged.

The underground transmission cable nearest to the explosion center was the Miyuki-Ote line. It was 2,300 to 6,600 ft distance. No damage was done to the underground parts and only slight damage resulted to terminals on the ground.

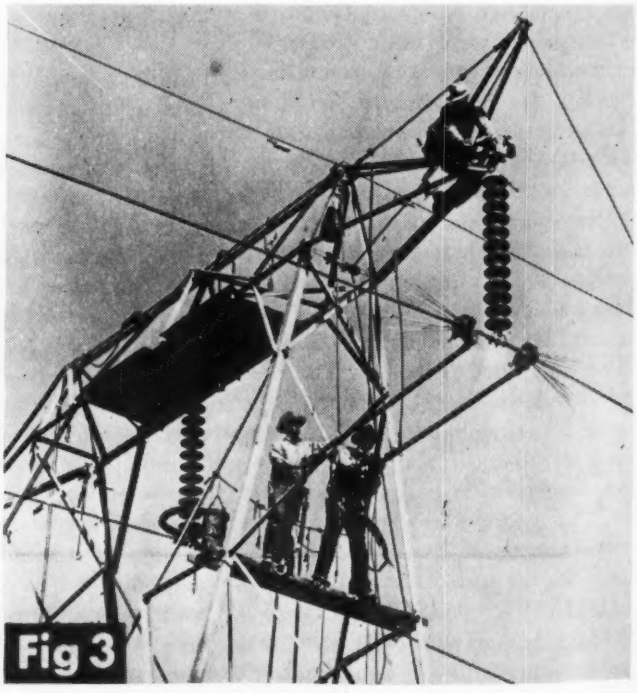


CLOSE-UP of armor rodding machine before being seated to conductor and clamped in position. Cradle is removed before wrapping of rods on conductor begins. Wrapping operation is performed by driving wood shafts of tool with electric drills

Procedure for Armor Rodding 220-Kv



READY TO detach and lower insulator for removal of old clamp and static ring, testing and general inspection. All stress is taken by sheaves and chain block mounted directly on tower members. Gin pole keeps hand line clear of live conductor



ARMOR RODDING MACHINE in operation. Each unit is a worm-driven, split-steel disk with ten equally spaced holes. Disks are rotated in opposite directions by insulating handles driven by portable electric drills. Homelite unit gives power for drills

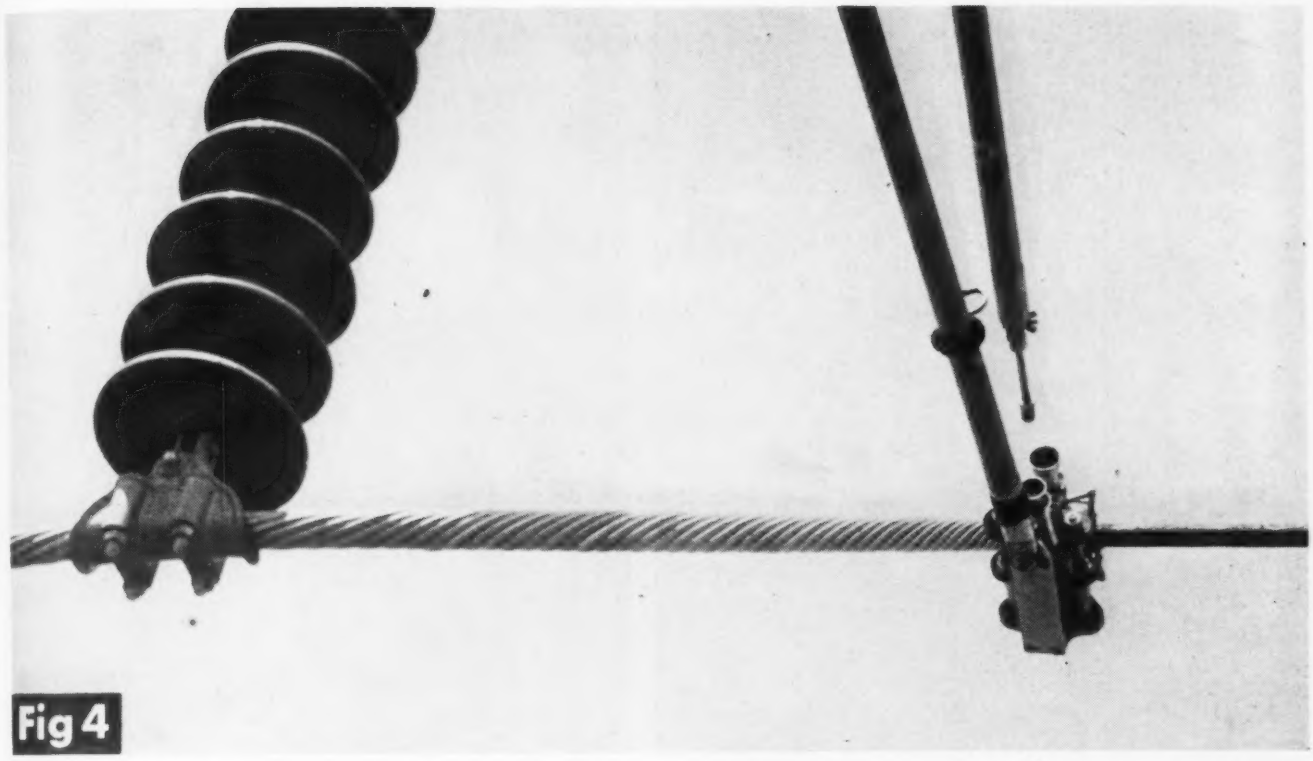


Fig 4

TOOL for applying button clamp on ends of armor rods. Visible on end of upper pole is hollow-bodied Allen screw which is guided by spring-loaded male member in tool to proper thread-starting position. Adjacent insulator shows comparative size of tool

Transmission Lines While Hot

Special tools enable two 14-man crews to armor rod eight towers per day with lines energized . . . Conductor vibration is effectively reduced with rods and low-loss aluminum clamps

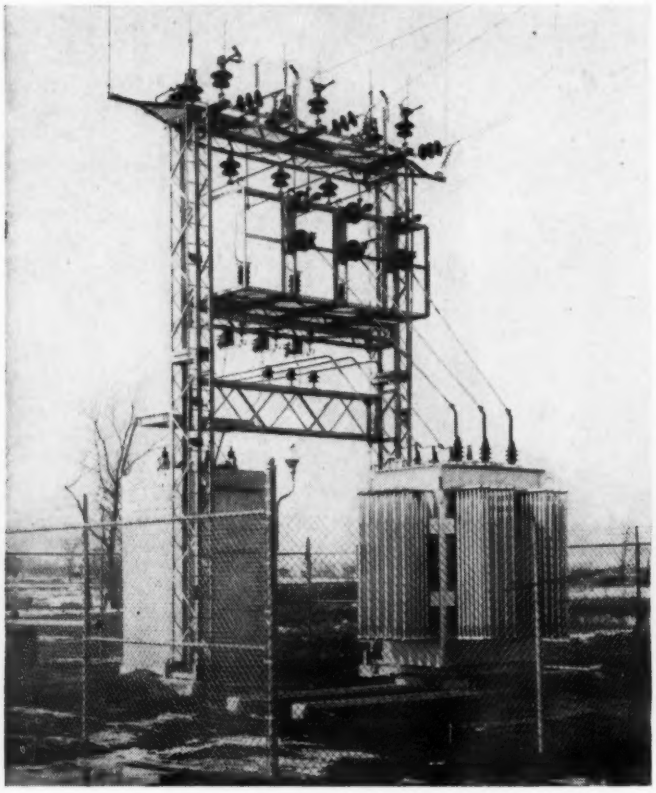
SOUTHERN California Edison's 220-kv Big Creek lines are being armor rodded with the lines energized. This is the first major rehabilitation on this pioneer 220-kv line since Stockbridge vibration dampers were installed in 1925. The present two-year program for the two 250-mile lines includes: Armor rods and new low-loss aluminum clamps; removal of static rings; testing of insulators; replacement of suspension pins; and general inspection and repair.

Equipment developed for hot armor rodding by H. A. Crowley, of the City of San Francisco, was modified for this job. It consists, in addition to the common hot-line items, of two special tools. One of these is for applying the armor rods; the other for placing the retaining clamps at the end of the rods. The armor rod wrapping tool, Fig 1, consists of two worm-driven, split steel disks with holes for the armor rods. These are placed in a hinged cradle. The lower half of the cradle is seated to the conductor. The top is closed so that the ten 99-in. tapered aluminum armor rods are equally spaced around the conductor preparatory to wrapping or spiralling. The spiral wrapping operation is performed by driving the wood insulating shafts of the tool with portable electric drills. Power for these drills is supplied from a 1,500-w, 115-v a-c Homelite gas-engine-driven unit. Fig 2 and 3 show stages in this wrapping operation.

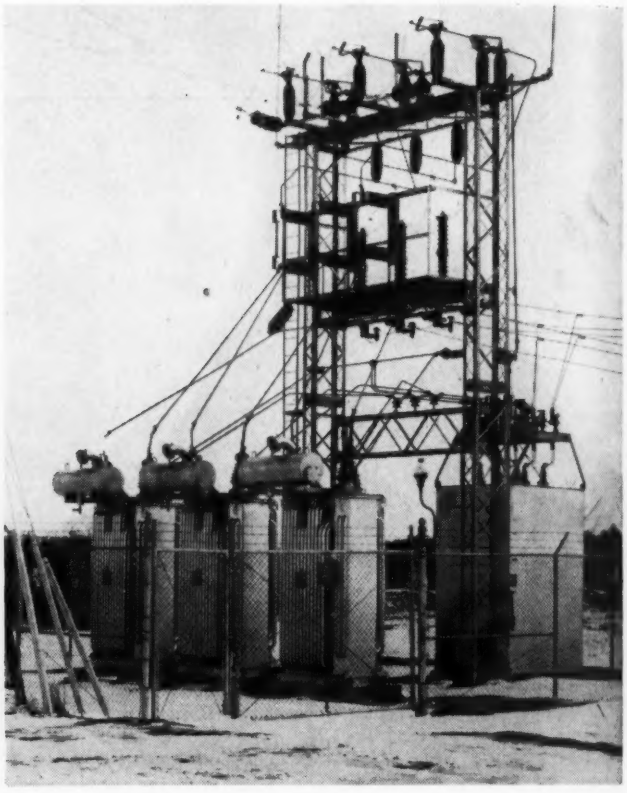
Clamps Applied

The special tool for applying the clamps consists of a hinged clamp holder with spring-loaded guides. These permit positive thread-starting of the hollow-bodied Allen screws that are used on the clamp. See Fig 4. Final operation is respacing the vibration dampers for more effective damping. The armor rod is expected to eliminate approximately 40 percent of conductor vibration, the dampers the remainder.

Two 14-man crews are used on the job. Each crew consists of two 6-man working units, three on the tower and three on the ground. A foreman and truck driver serve both. Progress is at the rate of four towers per day per 14-man crew. Considering the nature of the work, this speed is remarkable. Because of the hot line tools and techniques employed, the work is actually being done faster and safer than if the lines were deenergized.

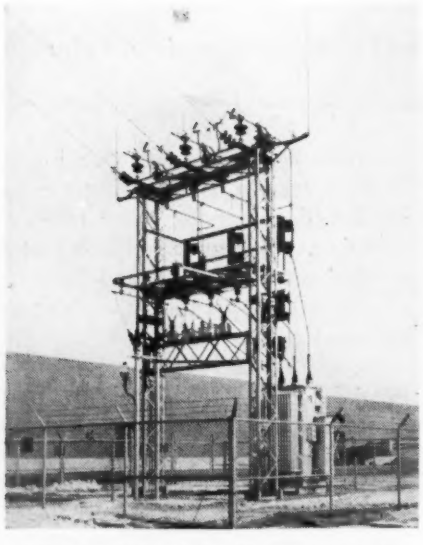


STANDARDIZED DISTRIBUTION SUBSTATION provides for three-phase transformer and feeder switch house

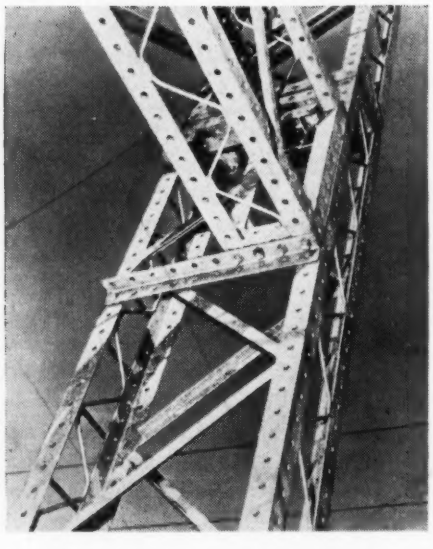


SAME DESIGN is modified to accommodate three single-phase transformers

Substation Design Remains Flexible



INDUSTRIAL SUBSTATION uses the standard structure with truss section for support of metering equipment and other standard parts for low-voltage disconnects. Erecticon design uses only three-fourths as much steel as normally required for conventional construction

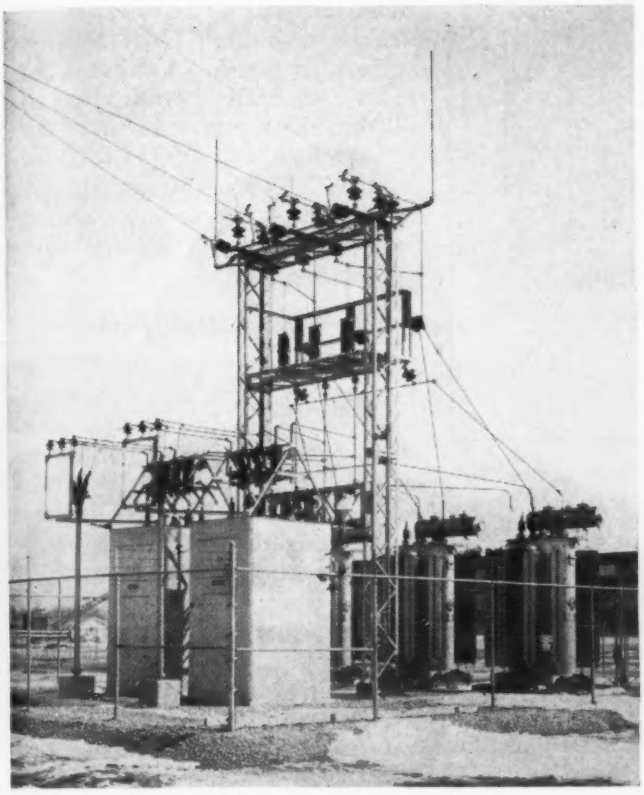


HORIZONTAL truss section may be joined to upright at any specified elevation. Flexibility is obtained with the punched holes and only added pieces are two side angles. Total cost is about one-half of that for conventional construction

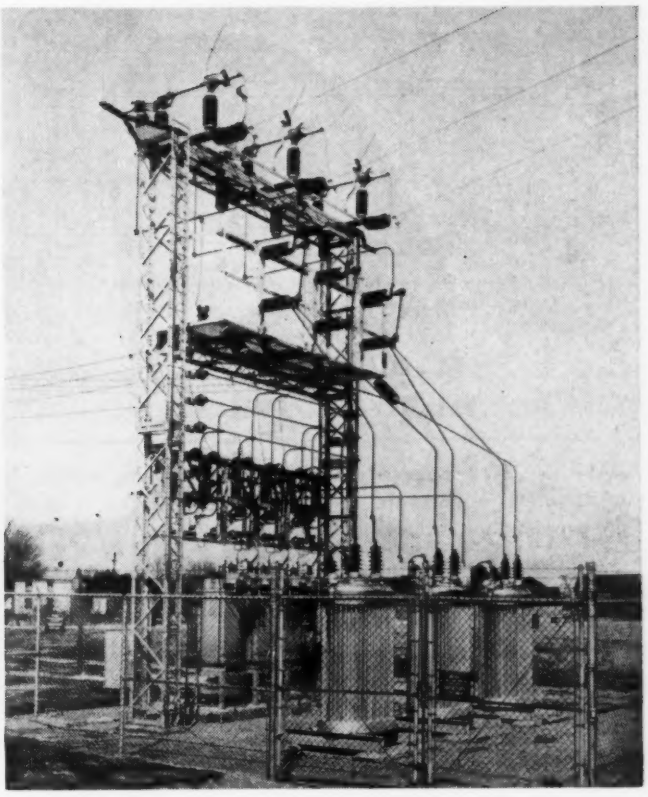
E. V. SAYLES
General Engineering Supervisor
Consumers Power Co
Jackson, Mich.

STANDARDIZED structural parts can be assembled to form complete substation structures. This is the basic feature of the Erecticon design developed and extensively used by the Consumers Power Co. With this design, a coordinated system of construction planning is possible. There is a minimum of time and cost required for detailed engineering plans, and field assembly of the standard shop-fabricated units is simple.

Compared to a structure using rolled sections with bolted members, the Erecticon design uses only three-fourths as much steel. Erection costs are about one-third. Total cost of the



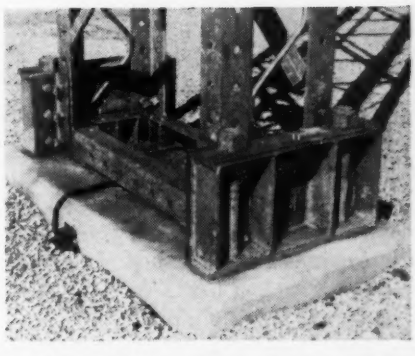
TWO FEEDER SWITCHES with underground exits require the addition of only a few more standard parts



TRANSFORMERS AND REGULATORS moved from an older substation are used in this new standard substation

With Erecticon Assembled Sections . . . I

Prefabricated, interchangeable sections for structure accommodate any wiring diagram and equipment units . . . A total of 103 standard stock parts are used resulting in large savings in layout and construction



COMPLETE foundation base is built around four anchor bolts. Clip angles and web channel are added to standard truss section

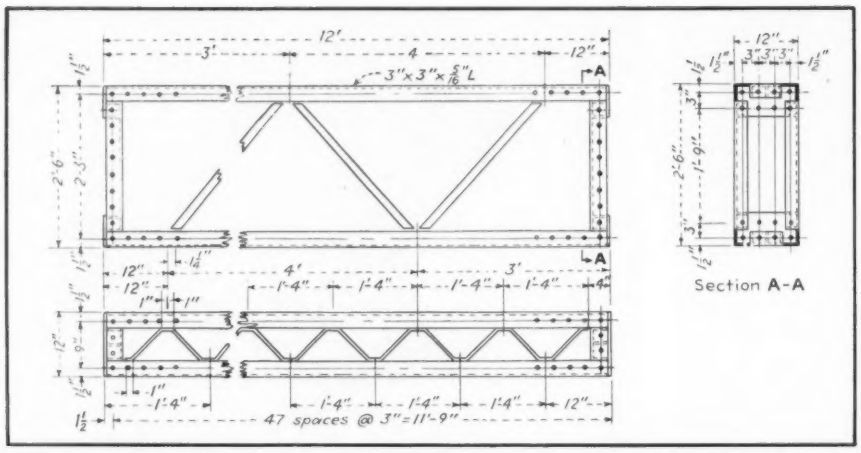
completed structure is about one-half of the cost of conventional construction.

A simplified substation design is often secured at the expense of flexibility. In systems where the voltages and the voltage regulating requirements are always about the same, design requirements can be narrowed considerably. But in these cases there still remain the all-important problems associated with replacements because of load growth or failures of equipment.

Because of substantial residential and rural load growth during the war years, the Consumers Power Co, early in 1945, was faced with the necessity of building a large number of new distribution substations. These new substations must range in capacity from a few hundred to several thousand kva. They must be supplied from high-voltage lines of either 23,000 or 46,000 v. Primary distribution circuit voltages are 2,400, 4,800, 7,200, or 14,400 v ungrounded or the wye connection of the first three of these into three-phase four-wire common neutral circuits of 2,400/4,160-, 4,800/8,320-, or 7,200/12,480-v rating.

The new substation designs must also be such that excess equipment currently on hand can be readily utilized.

The designs developed fulfill these



FABRICATED box-girder type truss sections are shop welded, with holes punched in all faces at 3-in. intervals. Units are in multiples of 4 ft up to 20 ft in length, and are galvanized after fabrication. Similar sections are used in 12-in. by 12-in. members.

requirements. Construction and operating experience to date has justified their being used for all new substations now being planned.

Structural Design

Main supporting members, both columns and trusses, are identical. They are made up of prefabricated light-weight welded sections. These members are of 12-in. x 30-in. uniform cross-section, and lengths are standardized in multiples of 4 ft. The 12-ft, 16-ft, and 20-ft lengths are most commonly used. But 8-ft and 4-ft lengths are available. These prefabricated members are of lattice-type construction having 3-in. chord angles. Each chord angle has holes at regular intervals (3-in. in both faces) that permit an almost unlimited variation of assembly. The welded sections can be bolted end-to-end with internal tension bolts. These bolts are adequate to develop the full strength of the structural members. In a few instances, splice plates have been used to provide an additional factor of safety.

In addition to the standardized trusses, other standard steel parts have been designed. These consist of channels, angles, brackets and plates for use in mounting trusses and equipment and for various attachments to the structure. In all cases, there are holes at regular 3-in. intervals to permit bolting at any location desired.

Each part is marked so that it can be readily identified. For example, a 2½-in. x 2½-in. x 59-in. angle (marked M-54) is used for a platform hanger member, a platform base member, a base angle for regulator bypass switch, a base angle for primary fuses, and a base angle for primary air break switches. Likewise a 2½-in x 2½-in. x 30-in. angle (M-53) is used for truss connections, for protective rod gap assembly, as a base angle for repeater fuse mountings, and as a part of the recloser mounting. Thus, it is possible to build any one of several types of substation structures with standard stock items.

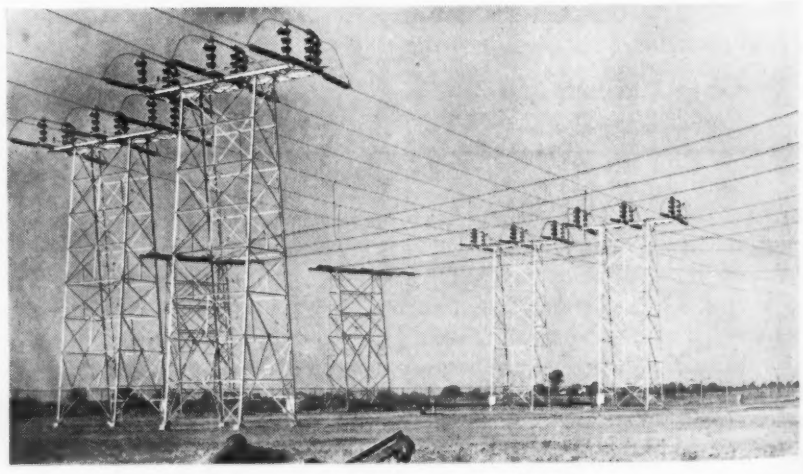
For mounting the trusses in a vertical position, two 9-in. channels are used as a base for each truss. The channels are bolted to the lower end of the truss and anchored to the foundations with four 1½-in. bolts per column. In a series of thorough full-scale tests, 8,000-lb tension was applied to the top of a 12-in. x 30-in. x 32-ft high column before failure occurred. Two of the anchor bolts finally failed. The mounting channels and welded sections were not damaged in the test.

Foundations Made Uniform

Much thought was given to the foundation requirements with particular reference to minimum excavation, simplicity of form work and time required for installation. The design adopted consists of a steel-reinforced grid, having a width of 12 ft, 16 ft, or any other 4-ft interval. This grid provides suitable foundations for the steel structure and the major substation equipment that is scheduled to be installed.

Foundations for all substations, regardless of the initial equipment requirements, are the same. But the width may vary by 4-ft intervals. Detail drawings have been prepared for the forms required for these foundations. These forms are designed so that they can be used for any width of foundation. They can be readily removed without destruction. Contractors or company construction forces build one set for use on all substation jobs.

Tapping A 110-KV Tower Line



ONE WAY TO TAP IN existing double-circuit 110-kv steel tower line is shown here. Each circuit was flattened out on two steel "A" frames; cross-bus was strung between steel "A" frames at 90 deg to, and 10 ft below, line wires. Aerial taps were made between the line wires and the bus. This method was used in tapping the city of San Francisco's Hetch Hetchy line when Modesto Irrigation District built a substation to take delivery of power

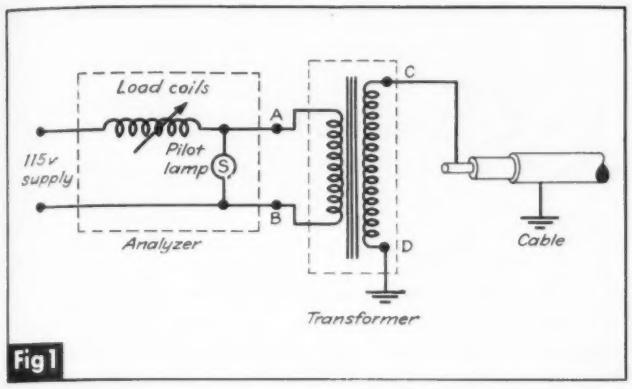


Fig 1

BASIC CIRCUIT of analyzer of Lundin set

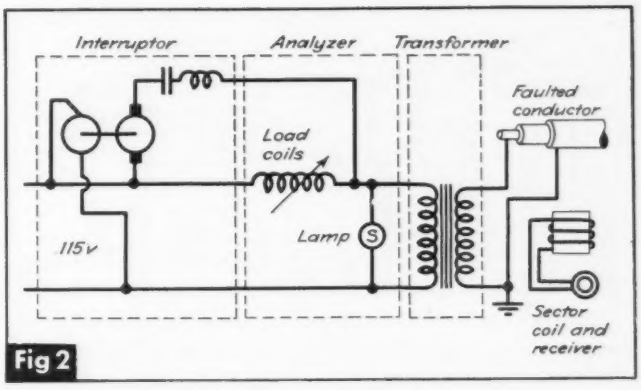


Fig 2

SCHEMATIC DIAGRAM of Lundin fault locator

Locating Faults in Underground Cables*

DOUGLAS F. TULLOCH
Boston Edison Co
Boston, Mass.

Combined testing equipment and methods employed to meet varied types of cable trouble . . . Trend toward established routines aided by progress

NO SINGLE DEVICE is satisfactory for locating all types of cable faults. This has been the experience of the Boston Edison Co. As a result, they use a combination of several devices. These are: The Lundin fault locator, Murray loop bridge and the Kenotron. The following are methods of fault location on 3-conductor, 13.8- and 24-kv cable in ducts or buried in the ground. These methods are generally applicable to other types of cables at other voltages.

The Lundin apparatus analyzes the fault type. The circuit for this equipment is shown in Fig 1. Load coils in the analyzer are current limiting reactors. When terminals *A* and *B* are not connected to the transformer, the pilot lamp burns slightly below normal brilliance. When the terminals are short-circuited (approximating a cable fault) the voltage drop across them becomes zero. The lamp goes out because the entire 115-v drop is across the load coils. Since 115 v is unsatisfactory for reduction or analysis of faults, a step-up transformer is provided. This enables potentials of 575, 1,150, 2,300, 4,600 and 6,900 v to be obtained at terminals *C* and *D*. If *C* and *D* are short-circuited, the equivalent impedance of the transformer is reduced to a low value. This creates the same effect as short-circuiting *A* and *B*, and the lamp goes out.

By connecting terminal *C* to a conductor suspected of being grounded and terminal *D* to ground, the fault type can be analyzed. The condition of the conductor as regards grounding can also be determined. A test for clear conductor can be made by applying the set to the cable and noting whether the lamp brightens. This indicates (on an ungrounded cable) a rise in voltage due to the capacitance of the cable and the inductance of the load coils being in series.

When a line fails, the troubleman orders it red-tagged. He then applies the Lundin set, usually at 575 v. If no fault is apparent the voltage is increased until a fault is indicated. The troubleman then tries to carbonize it and reduce it to the lowest possible voltage. A solid fault on the cable is indicated when the pilot light goes out at 575 v.

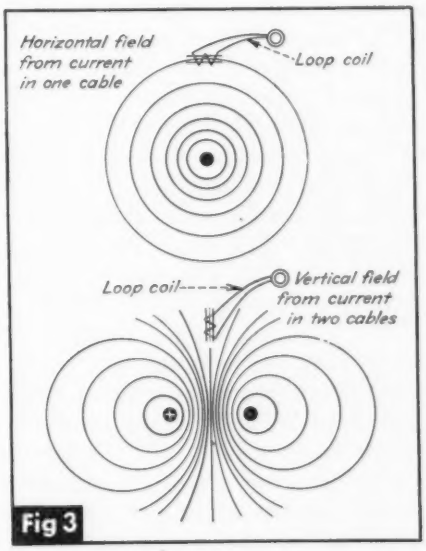


Fig 3

DIAGRAM of magnetic fields used by Lundin field coil

Classifying Fault Types

Four common fault types are encountered:

(1) Low-resistance fault. This occurs when the troubleman is able to carbonize the fault quickly, so that the pilot lamp goes out at 575-v with a 5-amp load coil.

(2) Open circuit. Occurs when the fault cannot be picked up on the Lundin set, but a conductor is found to be open and clear of ground on a continuity test.

(3) "Water fault." This type has a usual resistance of 3,000 to 5,000 ohms. It is indicated when the pilot light dims slightly at 575 v and

* From a paper before the Underground Distribution Engineers of New England.

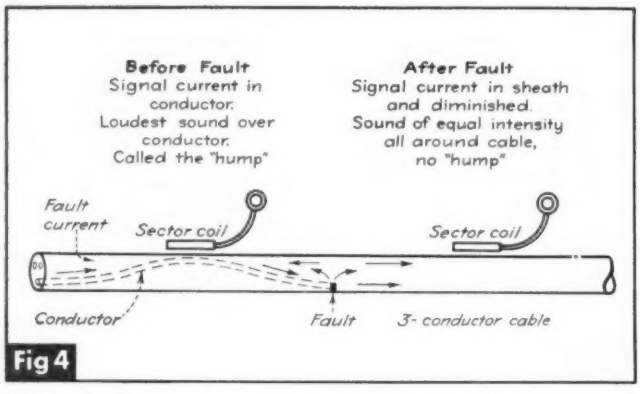


Fig 4

APPLICATION of sector coil on low-resistance fault

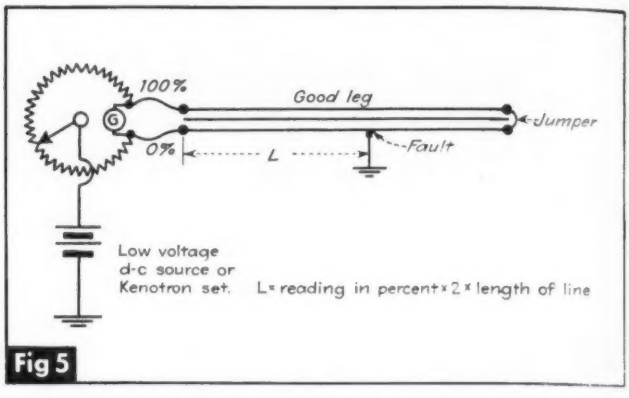


Fig 5

SCHEMATIC DIAGRAM of Murray loop bridge test

flickers when 2,300 v is applied. The pilot lamp cannot be made to go out at 575 v and never burns above normal candle-power. The Kenotron set will usually be required for fault location.

(4) High-resistance fault. This fault cannot be reduced by the Lundin set. The conductors are continuous as determined by a continuity test. The Kenotron will be required.

Field Work in Cable Testing

The low-resistance fault is located quickly and easily. The troubleman applies the Lundin set (Fig 2) to the faulty conductor, usually at the 575-v hook-up. With the interrupter connected across the load coils, a signal can be heard when the sector coil and telephone receiver are applied to the cable in the field, as shown. This signal resembles the busy signal on a telephone and is produced by chopping the 60-cycle wave with the interruptor commutator at about 57-58 cps. The combination of this frequency and 60 cycles gives a beat of about 2 or 3 per sec. The speed of the beat varies with the slip of the motor. A slow beat is most desirable. A loop coil consisting of an iron core with many lateral turns of wire is generally used on the front end of a car in conjunction with a 2-stage audio amplifier. The loop coil utilizes two types of magnetic fields. (Fig 3).

When a single conductor is involved in a belt circuit with the return by another route, the coil is used horizontally in the magnetic field around the conductor for maximum tone. Where two conductors are concerned, or a sheath with a spirally eccentric conductor within, maximum tone is obtained with the coil in the vertical position. In this case it utilizes the field of both conductors. This is the usual application. The coil is attached to the bumper of the car and connected.

The troubleman drives along the line and listens to the sound from the tracer current via the loop coil, amplifier and receiver. The interruptor sound drops off abruptly at the fault. The troubleman stops, enters the manholes, and locates the fault by applying the sector coil directly to the cable (Fig 4). Ahead of the fault, the major portion of the signal current is in the conductor, though a small part is usually returning on the sheath. The current in the conductor gives a signal which is loudest directly over the conductor. This is called the "hump." Beyond the fault, the current is in the sheath and gives a diminished sound of equal intensity all around the cable.

Open-Circuit Faults

The open circuit fault is handled as follows: All phases are found clear of ground with the Lundin analyzer, but a continuity test shows that a phase is open-circuited. The first step is to insert either a 0.5-amp or a 5-amp ammeter (according to the line length) in the high-tension lead from the Lundin set to the defective conductor. The set is energized at a voltage which will give a reading well up on the meter scale. The load coils are short-circuited to give full voltage at the terminal lead. This process is repeated with the ammeter connected in series with a good continuous conductor. The length of cable from the station to the open circuit compared to the total line length is proportional to the current taken by the defective phase compared with the current in a good phase. The set is then applied at the 575-v hook-up to the open phase, the other two phases being grounded at the knife blades. The troubleman proceeds along the line, listening with the sector coil. Since he listens only to charging current, the sound diminishes as he moves along. Another guide is the knowledge of the approximate location as determined by the charging current measurement. He listens carefully with the sector coil and receiver until he comes to the last manhole where he can hear a signal. The fault will then be in either of the next two sections or manholes. If the fault is not visible and the charging current measurement checks with the suspected sections, the cable is cut in the manhole between the two suspected sections and tested both ways.

Handling Water Faults

Until a few years ago it was very difficult to locate the so-called water fault. Now little trouble is encountered. Such a fault seldom can be carbonized and reduced to a low-resistance value. After analysis shows that the fault is in water, the troubleman makes a continuity test. He may find (a) a conductor open under water, or (b) all conductors continuous. For the first of these, the Lundin set is applied at the 575-v hook-up, with the other two phases grounded at the knife blades. The troubleman then proceeds along the line using the loop coil and the sector coil. The fault is located by the method described for the low-resistance fault. In most cases this method is successful, but occasionally the tracer current is carried through the water between the open ends. This causes the tracer signal to steal be-

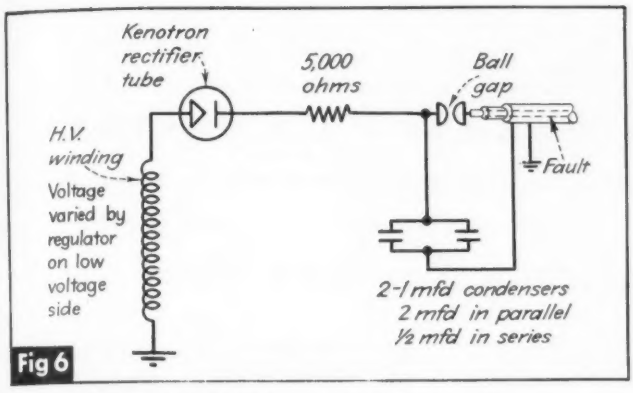


Fig 6

CONDENSER DISCHARGE method of fault location

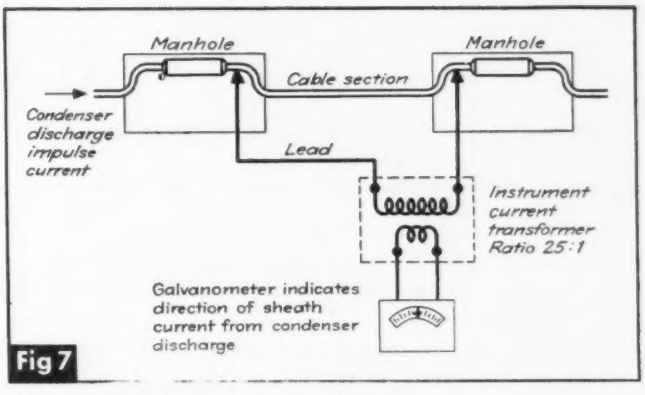


Fig 7

SHEATH DROP method of fault location

yond the fault. In such event the general area can be determined by the Lundin set. The condenser discharge test is applied while the troubleman listens for the signal.

The condenser discharge method is described under the next type of water fault (b). This is the fault where the conductors are continuous. The Lundin set cannot be used successfully on this type because the fault resistance is comparatively high and the tracer signal steals by the fault. In this case, the Kenotron is required. A fault will be immediately picked up by the Kenotron but it cannot be reduced. Usually about 100 ma can be passed through the fault at 1 kv. This amount of current can be utilized to make a bridge measurement using the Murray loop (Fig 5). This is at high voltage, the operator wearing rubber gloves. Above 1 kv the bridge is operated remotely by a wooden rod attached to the adjustable arm.

Murray Loop Test

The bridge measurement is a percentage of twice the line length. Hence the reading must be doubled to obtain the percentage of cable to the fault. After this measurement, the condenser discharge test is applied to the faulty phase. Two 25-kv, 1-mfd condensers are connected between the Kenotron test lead and ground, an adjustable gap being inserted in the test lead between the tap to the condensers and the faulty conductor. See Fig 6. For 13.8- and 24-kv cables the gap is set to flash over at about 25 kv d-c. A 5,000-ohm resistor is placed between the tubes and condenser tap to protect the former. In practice the Kenotron is energized and the voltage gradually increased until the gap flashes about every 2 sec. In this process the condensers are charged and then discharged periodically through the fault. The surge approximates a small stroke of lightning, and gives a loud signal at the fault. This signal can be heard through the duct line with the ear alone for as much as 200 ft. The troubleman goes to the manholes in the general location of the bridge measurement indication and locates the fault by listening. This procedure has been very successful, and is based on a method suggested by W. D. Fenn and L. A. Gray of the Simplex Wire & Cable Co, Cambridge, Mass., in an AIEE paper in 1944.

High-Resistance Faults

The high-resistance fault (4) is probably the most troublesome. But, fortunately, it is encountered very infrequently. When the troubleman cannot develop a fault and the conductors are tested and found to be continuous, a Kenotron unit is used. This carbonizes and reduces the fault to a low resistance. Thus, location becomes a process of finding a low-resistance fault with the Lundin set.

There are some faults which the Kenotron cannot reduce. These are usually called "bumper faults" because when a fault path develops, it immediately clears, causing a flash at the fault. The bumper-type fault can be bridged at high voltage if it bumps periodically (about once per second). With the Kenotron bumping the fault, the troubleman locates it by going to the bridged location and listening for the audible signal.

Occasionally, a high-resistance fault will not bump fast enough to obtain a bridge measurement. Instead it will bump infrequently and erratically.

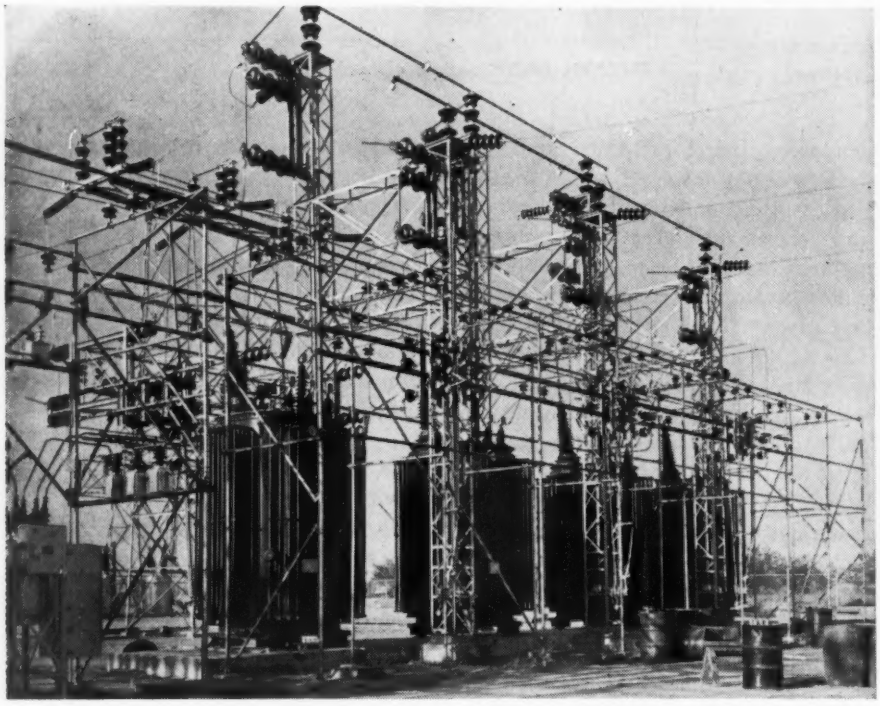
In this case, fault location is accomplished by patrol and by the sheath drop method (Fig 7). The theory of this method follows:

On a bumping fault, the defective cable acts as a condenser. The Kenotron charges the cable until its voltage rises high enough to flash over and discharge through the fault. This process is repeated with each bump. The impulse through the fault is, in effect, a direct-current charge which flows both ways on the sheath. Thus, the drop in the sheath is opposite in direction on one side of the fault to that on the other. Boston Edison uses a galvanometer with an instrument current transformer. This filters out the stray direct current. It is connected opposite to the usual way; i.e., the instrument side is connected across the sheath of the section of a cable. The line side of the transformer is connected to the galvanometer. The ratio is set at 25 to 1. The direction of the impulse is recorded as the troubleman applies the leads. He proceeds along the line making these tests, always keeping the leads in the same relative position. Upon passing the fault, both the impulse current and the galvanometer reading are in the reversed direction. In this manner the fault is located. At the present time an amplifying directional indicator is being built that will speed up the process. With this unit it will not be necessary to run jumpers between manholes; a sheath drop indication will be given by applying the probes to the cable sheath at each duct edge in a manhole. This device is still in the experimental stage at the present time.

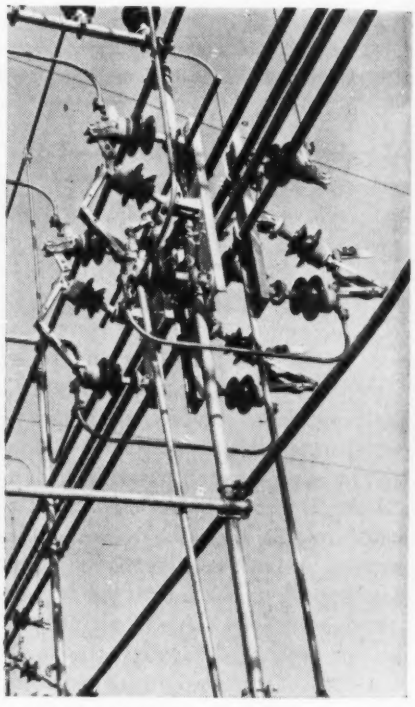
HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Spare 10,000-Kva Transformer Switched Hot



115-KV AND 69-KV TIE BUSES to spare transformer involved in cutting spare in and out hot and under load are shown in upper portion of photograph. This station sometimes carries the total load of the Modesto Irrigation District



TRANSFORMER charging current is broken by these 12-kv air break switches when spare transformer is cut in and out

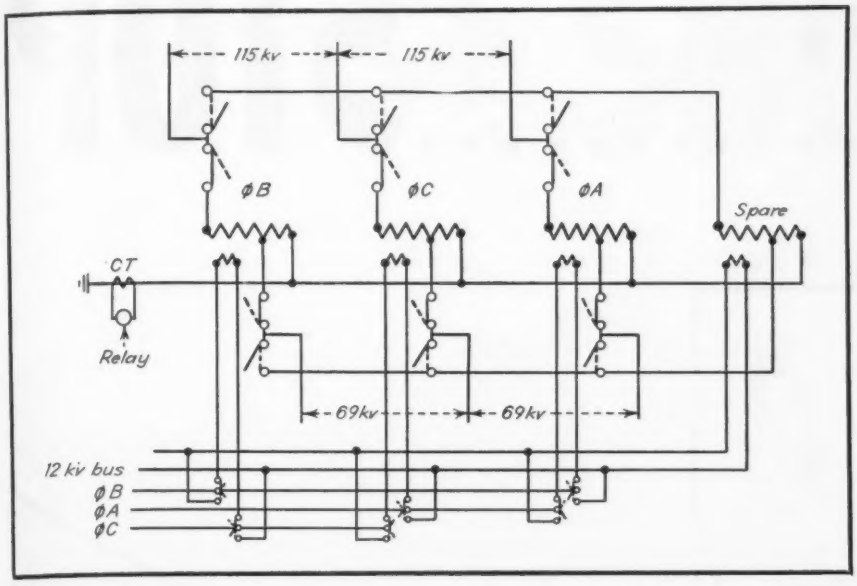
C. E. PLUMMER
Electrical Engineer
Modesto Irrigation District
Modesto, Calif.

AT ITS NEW 30,000-kva substation tapping San Francisco's 110-kv Hetch Hetchy line, the Modesto Irrigation District resorted to switching the fourth, or spare, 10,000-kva transformer in and out of the bank without deenergizing and while the bank is carrying load. This station will at times be carrying the total load of the district and at other times a major portion of it. There being only one bank of transformers, it was necessary to work out a scheme to switch any one of the four transformers in and out of service without deenergizing the bank.

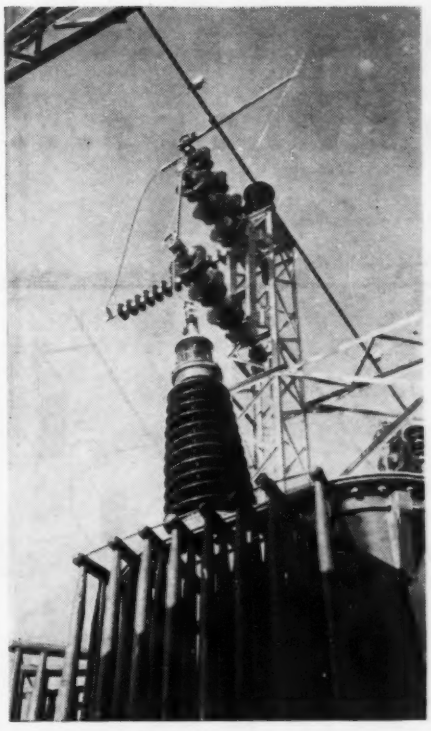
This was accomplished by means of air switches as shown in the accompanying diagram. Charging cur-

What Transport for Mobile Substations?

PACIFIC GAS & ELECTRIC CO. solves this problem by assigning an old truck permanently to the mobile substation. The truck, as shown, also transports the large reels that carry primary and secondary cable leads. This is claimed to be more dependable than the facilities offered by outside truckers



SCHEMATIC of 115/69/12-kv transformer bus connections providing for immediate use of spare transformer



DOUBLE ACTING 115-kv disconnect used in switching spare transformer

rent of the transformers is both made and broken by the 12-kv air break switches as shown in one of the accompanying illustrations. The upper portion of the transformer bank photograph shows both the 115-kv tie bus and the 69-kv tie bus to the spare transformer. A third picture shows the double-acting disconnect on the 115-kv bus. There are interlocks between these switches so that both cannot be opened at the same time. The same is true of the switches on the 69-kv side, which are a similar type.

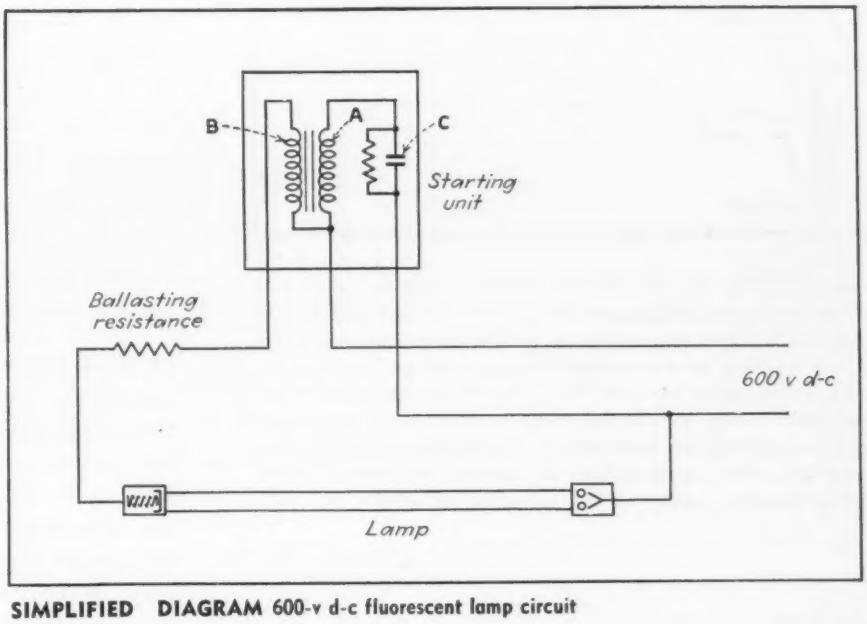
Feasibility of this rather unusual practice on such a large bank was demonstrated to the writer many years ago; an operator inadvertently performed such an operation without incident on a large bank of substation transformers.

• • •

Fluorescent on 600-V D-C

CONDENSER DISCHARGE starts the fluorescent lamps being used on cars of the New York subway system. The lighting, developed by Sylvania Electric and incorporating a new type of starting circuit, operates on 600 v, the traction power.

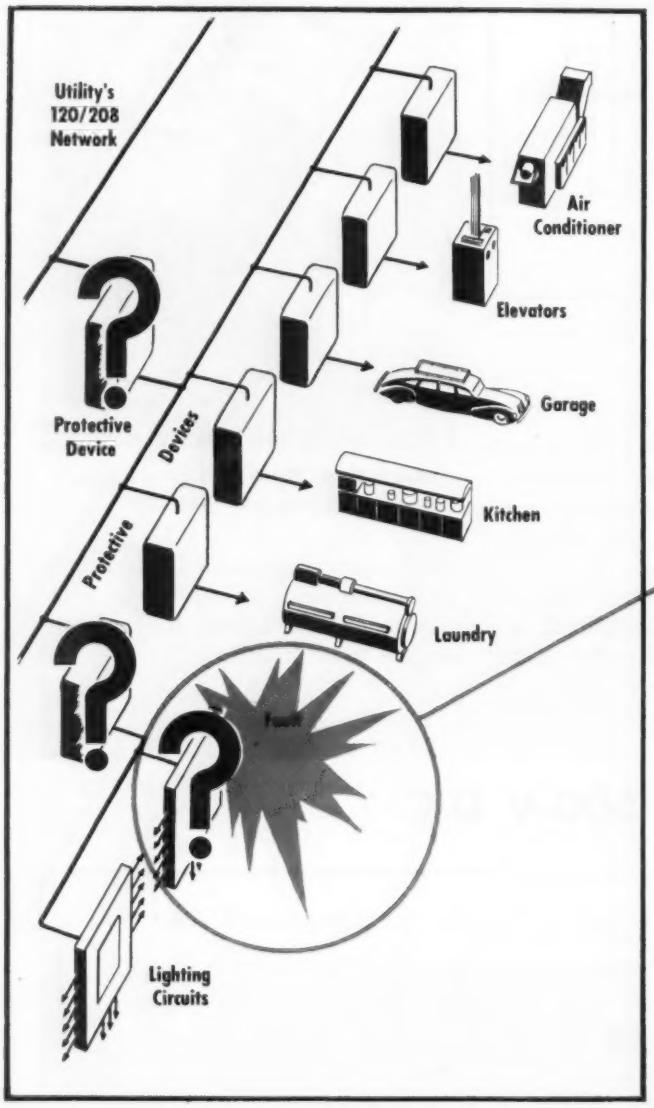
The lamp is of cold-cathode, instant-starting type, 72 in. long. It is specially produced for traction service. It has an average rated life of 8,000 hr. This is despite the very high frequency of starts and stops caused by passage of the train over third-rail gaps. Mercury drift, causing one end of the tube to blacken, is characteristic of d-c operation. It will be avoided by daily reversal of current by a manual switch. As is usual in traction service, voltage fluctuations are quite wide. They range from 400 to 750 v, but are of short duration and present no difficulty in transit operations.



SIMPLIFIED DIAGRAM 600-v d-c fluorescent lamp circuit

The starting operation is based on the condition that the unlit lamp is a non-conductor at operating voltage. When the circuit is energized (see diagram) the first available current path is through the "A" side of the

COULD YOUR PROTECTIVE DEVICES..... STOP



Because of the high kva capacity of a network system, bad shorts may draw tremendous surges of current that may blast protective devices of inadequate "IC." Loss of power to all facilities may result; equipment and personnel may be endangered by flying metal and fire. G-E air circuit breakers afford adequate "IC" protection, isolate shorts at their source, and do away with the possibility—and hazard—of over-fusing. Also, all costs of replacing fuses are eliminated. Be sure to check with your nearest G-E sales representative for complete information before installing protective devices on installations fed by a network system.

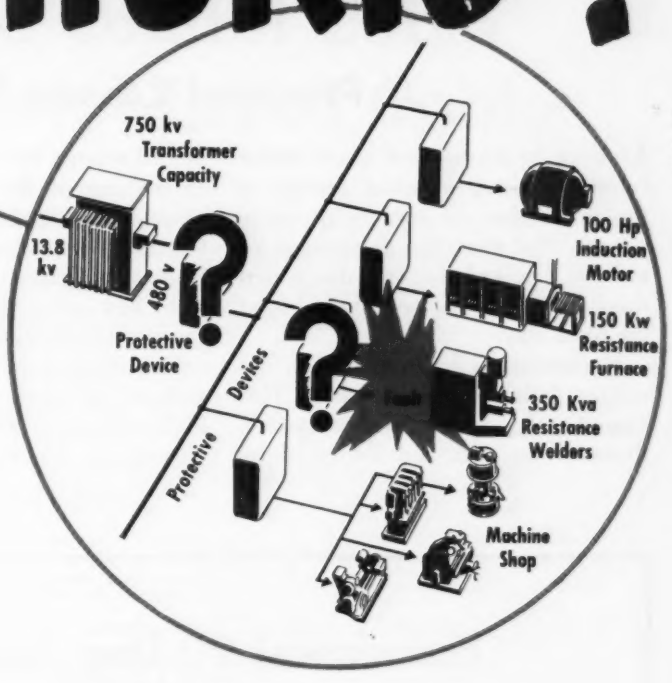
. . . PREVENT

You're gambling with production, equipment, and personnel if your protective devices have inadequate "IC." Inadequate "IC" means that the device, whether it's an air circuit breaker, fused knife switch, or oil circuit breaker, is unable to handle the full short-circuit currents available on a low-voltage system. Under such conditions devices may fail, resulting in costly power shutdowns and loss of protection, besides hazards to personnel. Be sure of your "IC." Here's how . . .

KNOW THE "IC" of your low-voltage protective devices. The interrupting capacity of a circuit breaker or other protective device is the maximum current it is rated to *adequately* interrupt.

BE SURE THE "IC" IS ADEQUATE to interrupt maximum short-circuit currents. Maximum short-circuit current is *not* determined by the normal load on the circuit. The total capacity of the transformers feeding the circuit is the critical factor. In the adjoining table, check your transformer capacity against the "IC" corresponding to your particular circuit voltage. The interrupting capacity of your protective devices should be equal to or greater than the short-circuit currents available as determined by your transformer capacity.

THESE SHORTS ?



That protective device ahead of the fault should have an "IC" (interrupting capacity) rating of 25,000 amperes. Anything less* can mean danger in the form of a destroyed device, flying metal, or possibly flaming oil. If the protective device on the branch feeder explodes or fuses together because of inadequate "IC," it means a power shutdown in the entire plant with consequent production losses. If your installation is similar to the one shown, refer to the table below and check the "IC" of *your* protective devices.

*Some fused knife switches and oil circuit breakers may have a maximum "IC" of only a few thousand amperes.

POWER SHUTDOWNS

INSTALL G-E AIR CIRCUIT BREAKERS if you need more "IC." It's easy to select the proper G-E air circuit breaker from the table. And you can be sure they have adequate "IC" to safeguard your production, equipment, and personnel. By providing three-phase interruption of dangerous overcurrents, G-E breakers eliminate the possibility of single-phasing damage to motors. Workmen can operate these breakers easily. A turn of the handle and power is restored—no parts to be replaced.

WRITE FOR THESE BULLETINS on G-E air circuit breakers, or contact your G-E sales representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GEA-3600 AE-1 Air Circuit Breakers
GEA-3642 AL-2 Air Circuit Breakers
GET-1113 Selection and Application of Breakers
GET-1233 Short Circuit Currents in Industrials
GEA-2596 Low-voltage Metal-enclosed Drawout Equipment
GEA-3592 Load-center Unit Substations

INTERRUPTING RATINGS—G-E AIR CIRCUIT BREAKERS TO USE

Transformer Capacity in Three-phase Kva	220-240 CIRCUIT VOLTAGE				440-480 CIRCUIT VOLTAGE				550-600 CIRCUIT VOLTAGE			
	Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†	
	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use
300	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15	25,000	AE-1-25	15,000	AE-1-15
500	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15
750	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	50,000	AL-2-50	25,000	AE-1-25
1000	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50
1500	....	....	....	....	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50
2000	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	75,000	AL-2-75	75,000	AL-2-75
2500	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100
3000	....	....	....	....	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100

Note: This table is based on unlimited power supply and 5 per cent transformer impedance.
†If cascading of feeder breakers is used, it is possible that a smaller breaker may be used for branch-feeder service.

GENERAL ELECTRIC

660-52

double-wound choke coil. Thus the condenser "C" is charged. It discharges into the tube and establishes conductivity through it. Follow-on current then flows through the lower resistance path of the "B" side of the choke coil and keeps the lamp lighted. Flow of direct current through the "B" side greatly increases the impedance of the choke coil and quickly damps out current oscillations from the condenser.

• • •

A Practical Lesson in Cable Protection

IT PAYS to flame-proof plant feeder cables and keep overload setting of feeder breaker in tune with cable ratings. The electrical department of a New England factory discovered this. But they learned their lesson the hard way.

Mechanical vibration led to insulator failure between buses. This caused arcing on the bus duct system. Parts of the duct and feeder cables melted when a 600-amp circuit breaker on one of the six 440-v, three-phase, 500,000-cir mil feeders failed to trip. Overheating ignited the cable insulation. Control wiring and a junction box were damaged. This, of course, halted production.

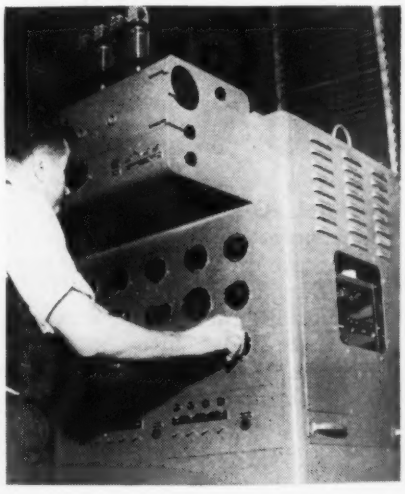
The short circuit in the bus duct and ground at the junction box had high resistance. This made the fault current too low to trip the breaker. The breaker setting and automatic operation were tested and adjusted to trip at not over 150 percent of cable rating. Combustible cable covering on important power circuits at switchboards, generators and in junction boxes was flame-proofed. This was done by wrapping cable covering with asbestos tape with 50 percent overlap and then coating the covering with sodium silicate.

• • •

Economical 90-Deg Turn

AN EASTERN TRANSMISSION CIRCUIT making a right-angled turn illustrates an unusually simple design in which each phase wire terminates on a three-disc strain insulator bolted into a separate pole per phase, with short jumper tying the ends together as shown. A separate pole carries the ground wire above and at one side of the cicuit, maintaining the symmetrical parallel provided throughout the circuit run. Each of the phase-wire poles is guyed in triplicate and the ground wire pole in duplicate, all guys being interrupted by insulated rods at their upper ends. Crossarms were eliminated as well as considerable line hardware. The construction being in open country removed objection to the use of eleven guys for the turn. The overhead ground wire was jumpered around the pole top with a run of but a few inches of conductor. This turning technique resulted in a considerable reduction of costs

New High-Speed Recording Oscillograph

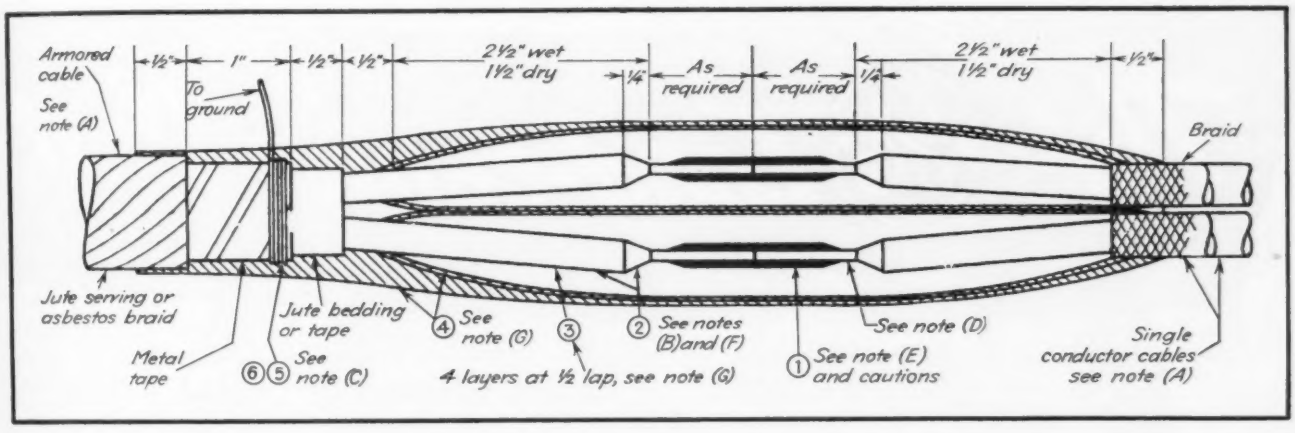


THIRTY SECONDS from surge to projection of the oscillogram negative on a built-in screen is the record of this GE laboratory unit

THIS recording oscillograph is estimated to cut the time for testing electrical apparatus to about one-tenth the usual time. A fast film-developing cycle is a big factor in this saving. As soon as the surge picture is taken, automatic film developing equipment starts. In 24 seconds the developing cycle is finished. The negative moves into another compartment where a projector throws the image, enlarged ten times, on a ground glass screen. From this the operator gets an accurate picture of apparatus performance during the test surge.

How To Joint Braided Control Cable To Multiconductor Metal-Taped Cable

A procedure for jointing armored and braid-covered types of 600-volt control cables used in generating stations and substations; comprises instructions in the forms of notes, an illustration and a bill of material; adapted from a standardized method of Philadelphia Electric Co



Construction Notes

(A) Use this joint for connecting rubber-insulated multiconductor metal tape and braid-covered control cable to single-conductor control cable or for connecting two lengths of this multi-conductor cable. In the latter case use the construction shown for the metal-taped cable in the left half of the sketch.

(B) Remove the coverings for the distances shown.

(C) Bolt zinc strap around the metal tapes near the end. Allow sufficient length on one end of the strap for grounding or bonding. If the joint is to be buried, use bare wire, tack soldered to the tapes as shown for grounding.

(D) Remove the required length of insulation from each conductor. If the joint is to be soldered, do not scrape the conductor, but clean by rubbing with a coarse cloth.

(E) Press or solder conductors in sleeves.

(F) Taper insulation with sharp knife. Finish taper and roughen insulation with a rasp, coat with rubber cement and allow to dry until tacky before applying rubber tape.

(G) Insulate each conductor with four layers at one-half lap of rubber tape, protect this insulation with one layer at one-half lap of friction tape over each conductor. Protect the whole joint as shown with two layers at one-half lap of friction tape. Coat finished joint with asphaltic paint. If the joint is to be buried, add one layer of glass tape applied at one-half lap.

Bill of Material

Item	Description
1	Pigtail joint[a]
	Split connector[a]
	Pressed connector[a]
	Stearic core solder[b]
	Rosin core solder[b]
	Asphaltic paint
2	Rubber cement
3	¾-in. rubber tape
4	¾-in. friction tape
5	No. 10 bare copper wire[c]
6	Zinc strapping[c]

a, b, c Alternates for respective indicated items

CAUTIONS

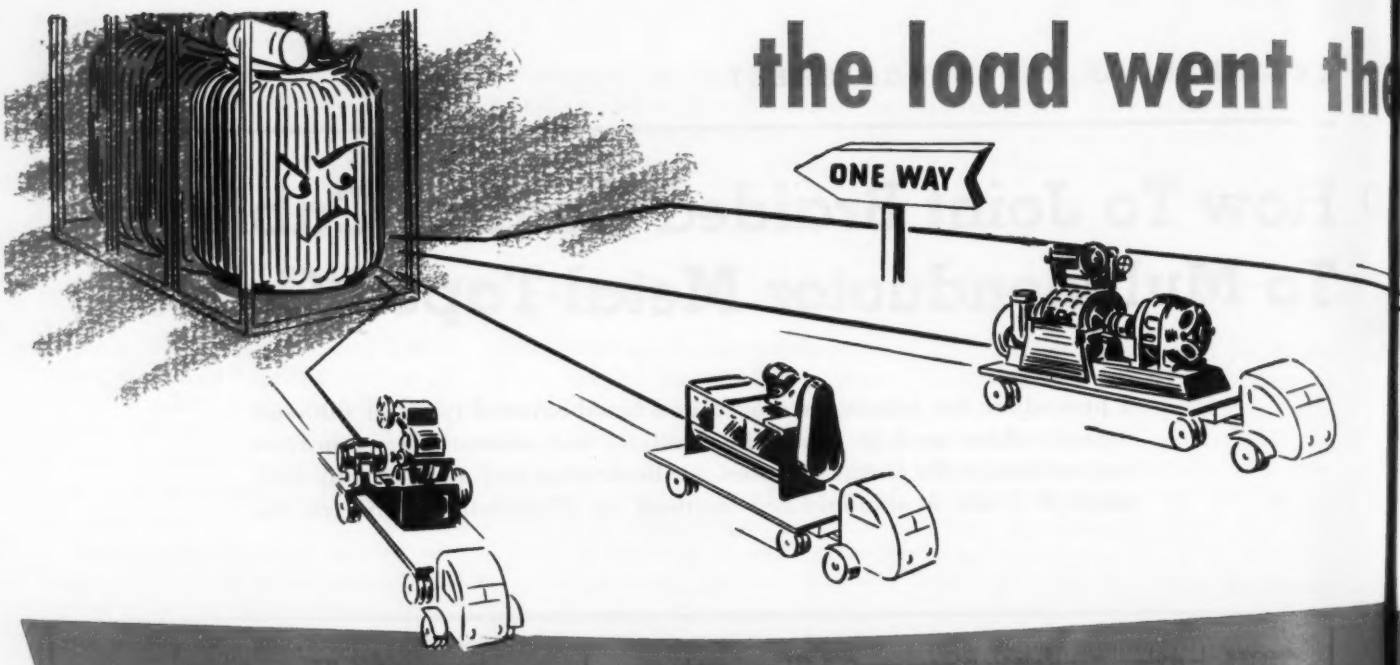
Protect all cables at duct mouth and hangers with two layers of friction tape coated with asphaltic paint.

Do not stretch rubber tape to less than three-fourths of original width.

Minimum working temperature of rubber tape is 40 deg F.

Use pigtail joints or pressed connectors in current transformer circuits and bolted lugs on apparatus leads.

Ground and bond the metal tapes of this cable.



This GE Load-center Unit

This G-E load-center unit substation was put on the job close to the center of the shifting load area.

That meant that two more heavy secondary conduits did not have to be run all the way from the main substation, 500 feet away. It meant $1000 for the installed cost of the cable instead of $4000—a saving of $3000.

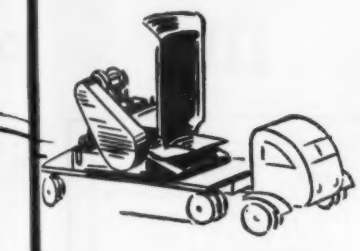
Plant engineers of the Staley Milling Company also credit the substation with eliminating severe—and costly—voltage fluctuations that used to hamper production. What's more, the 13,800/480-volt load-center installation gives them valuable flexibility for future expansion of the power system of this fast-growing plant.

The inherent flexibility of G-E load-center unit substations may offer a dollar-saving solution like this for your next plant distribution problem. When it comes up, get in touch with your G-E sales representative. He will gladly offer recommendations based on General Electric's experience with thousands of plant distribution problems.

Apparatus Department, General Electric Company, Schenectady, N. Y.

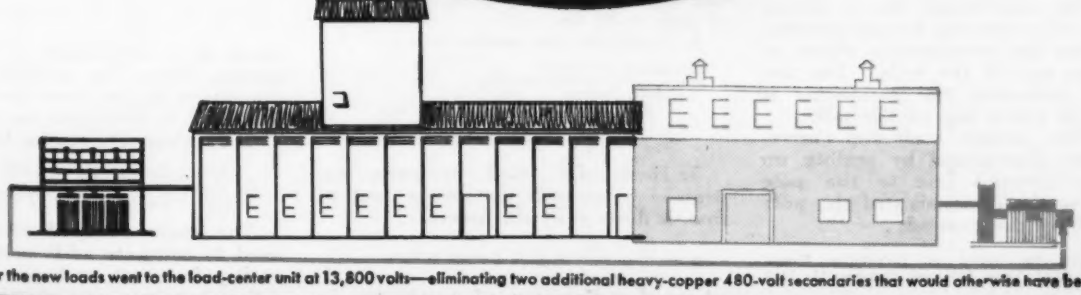
GENERAL ELECTRIC

...wrong' way



The electric load moved away from the main substation instead of toward it, as originally planned. As a result, heavy secondary conduits reached out 500 feet. New equipment to be installed would have required two more of these heavy secondary cables—at $2000 each.

Followed And Saved $3000!



Power for the new loads went to the load-center unit at 13,800 volts—eliminating two additional heavy-copper 480-volt secondaries that would otherwise have been needed.

Transmission Line Design Simplified by Graphical Aids . . . III*

HAROLD V. WINGFIELD†
Sverdrup and Parcel Consulting Engineers
San Francisco, Calif.

With limiting factors indicated on a single chart (accompanying Chart 3), the designer can decide what the normal span length will be in relation to the class and pole height. Equivalent wind load on pole and horizontal conductor separation are obtainable from Charts 1 and 2 of this series.

Chart 3 represents a composite picture whereby several transmission line design factors are illustrated for a comprehensive study. It is constructed for conditions of level ground. In case of hilly terrain or supports at unequal elevations, special treatment as described in several texts is required. To explain the procedure for constructing a similar chart, it will be necessary to assume some factors. For an example, assume Grade B construction, line voltage at 69 kv, conductor size of No. 2 AWG hard drawn three-strand copper wire, flat construction in a rural area under heavy loading district requirements. Procedure for construction of the chart follows:

(A) The ground clearance line is laid out at 20 ft plus 0.5 in. for each 1,000 over 50,000 which is approximately 20.8 ft above the ground line for 69 kv. This line is extended to a point indicating 175 ft. This dimension of 175 ft represents the maximum span length, in heavy loading districts, as specified in the NESC for application of the basic clearance. The specifications are entitled as follows:

Basic clearances—Rule 232-A and Rule 232-A Table 1

Increased clearances—Rule 232-B-1-(a) (1), and Rule 232-B-2

From this point a slope line, representing increased clearance required for longer spans, is computed and drawn by using 0.1 ft for each 10 ft of span in excess of the basic 175-ft length.

(B) Conductor sag is determined from data contained in applicable published (Copper Wire Engineering Association) sag charts for the conductor considered, using the sag for 60 deg F, no wind and no ice, which is the condition as defined in the NESC handbook. The sag line is drawn by scaling above ground clearance line.

(C) The pole height line is drawn above or below the sag line, depending on whether the conductor is above or below the top of the pole. For the example indicated, the conductor is about 1 ft above top of the pole.

(D) The upper stair-step increments are determined by scaling up from the ground line to the pole height line the dimension of the pole height above the ground.

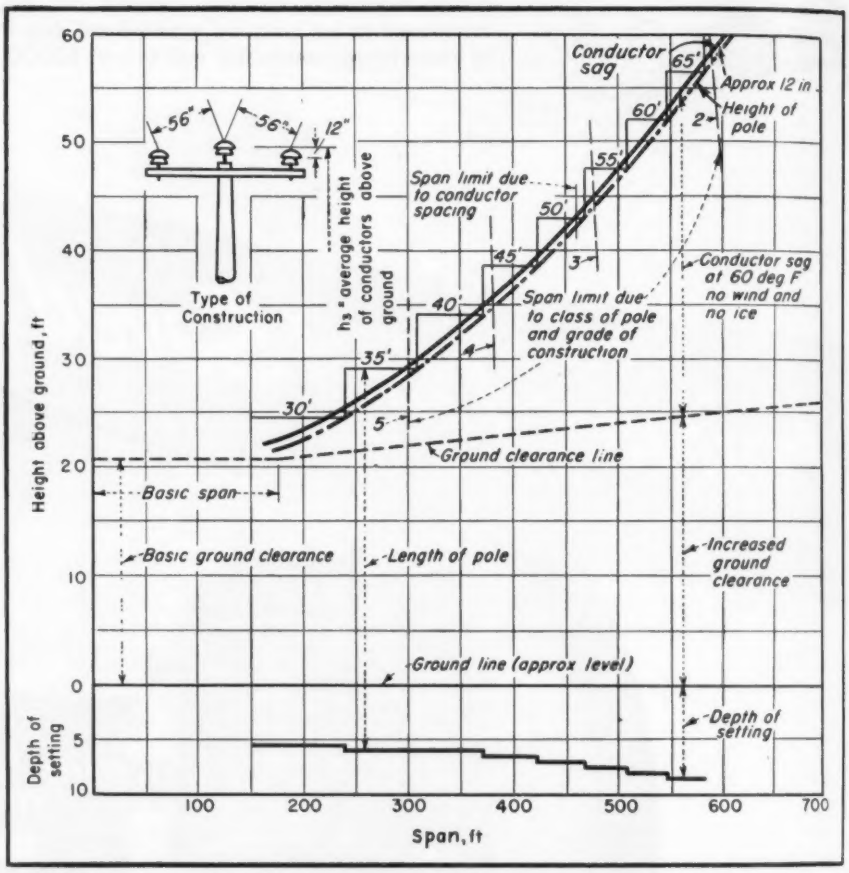


CHART 3 shows relationship between pole height and span length.. Illustrating factors for: Heavy loading district, Grade B construction, 69 kv, No. 2, 3-strand, H. D. copper conductor, and span limits due to pole class and conductors spacing

(E) The lower stair-step increments should correspond in span lengths with those above, in accordance with setting depths established by general practice.

(F) Establishing the limit for the various classes of poles follows: For an example, assume a Class 5, 35-ft pole:

1. ASA assigned breaking strength = 1,900 lb.

2. Safety factor (25 percent of ultimate fiber stress), (NESC rule 261-A Table 20) = 4.

3. P_w (from Fig 1 in first installment) = equivalent transverse load due to wind on the pole 2 ft from top of pole = 39 lb.

4. Available for conductors =

$$\frac{\text{Breaking strength}}{\text{Safety factor}} - P_w$$

$$\text{or } \frac{1{,}900}{4} - 39 = 436 \text{ lb.}$$

5. Horizontal wind pressure, expressed in pounds per linear foot of line, is derived by the formula:

$$p = \frac{(d + 2t)}{12} \times f \times 3 \text{ conductors}$$

where d = diameter of conductor in inches (for No. 2 AWG 3-strand copper = 0.32 in.); t = 0.5 in. in radial thickness of ice; f = NESC specified unit wind pressure of 4 lb per sq ft upon projected area of conductor.

Therefore, in pounds per linear foot of line

$$p = \frac{(0.32 + 1.0)}{12} \times 4 \times 3 = 1.32 \text{ lb.}$$

6. C_w = equivalent transverse load due to wind on conductors 2 ft from top of pole. Therefore, expressed in pounds per linear foot of line,

$$C_w = \frac{\text{pounds per linear foot of line} \times h_3}{h_2}$$

$$\text{or } C_w = \frac{1.32 \times 30}{27} = 1.46 \text{ lb}$$

where h_3 = dimension in feet of conductors above the ground line h_2 = dimension in feet from ground line to a point 2 ft. from the top of the pole.

7. Maximum span, for level ground.

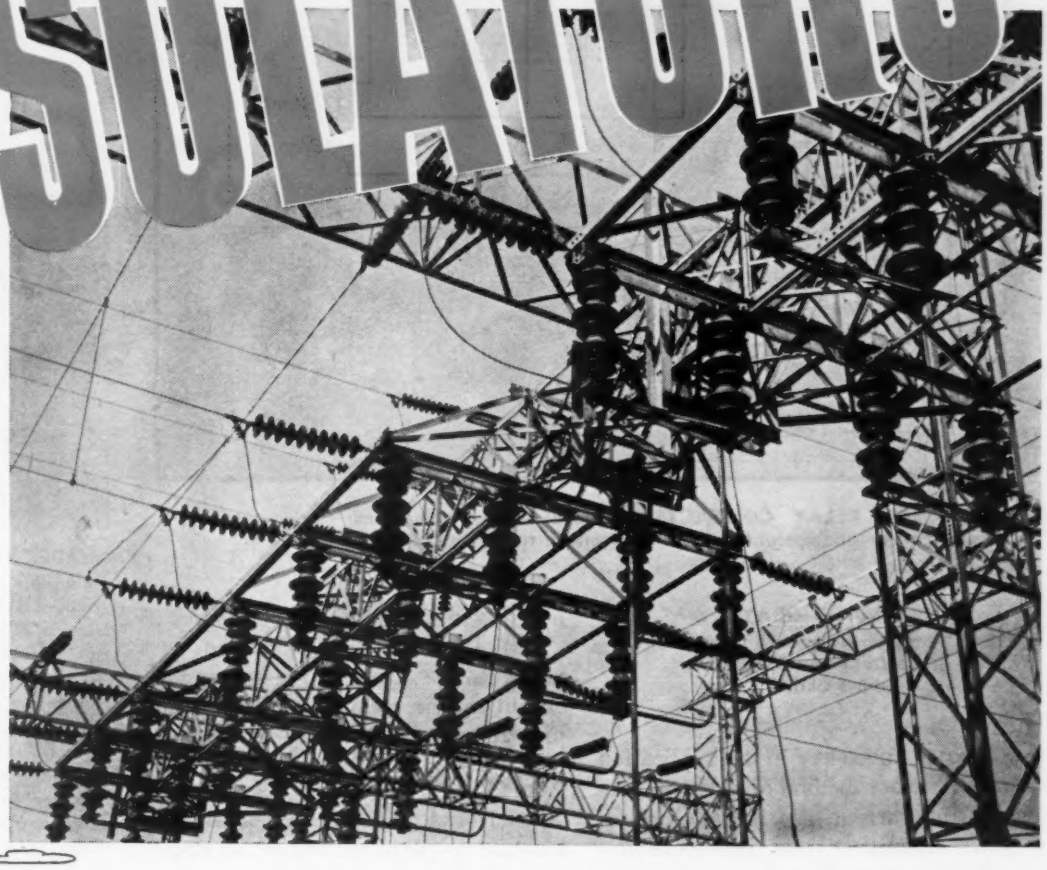
$$= \frac{\text{Avail. for cond's}}{C_w} \text{ or } \frac{436}{1.46} = 298 \text{ ft.}$$

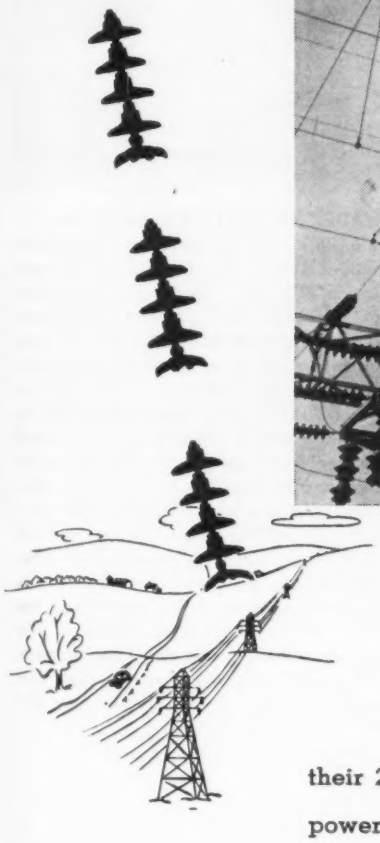
The steps outlined above may be used to compute additional points for each pole length and class. These additional points are plotted and connected to indicate span or sag.

* Concluding the series in ELECTRICAL WORLD, October 11, 1947, page 119, and October 25, 1947, page 132.

† Formerly electrical engineer, U. S. Department of Interior, Office of Indian Affairs, Los Angeles.

INSULATORS





In the heart of the Pennsylvania mountains where winter weather is severe, and summer storms both frequent and intense, these O-B insulators--suspension, pintypes, and station--have all reached their 25th year of notable service. As newer lines have been built, this power company has needed nothing more than its own operating records for making O-B its continued CHOICE OF INSULATORS.

Ohio Brass

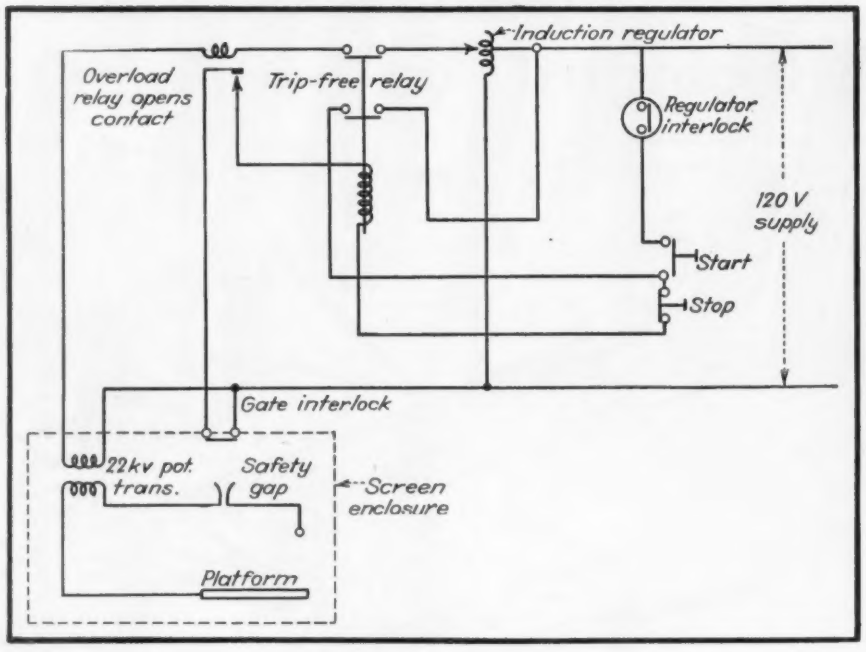
2753-H

MANSFIELD, OHIO

Canadian Ohio Brass Company Limited
Niagara Falls, . . . Ontario

HEADQUARTERS FOR PORCELAIN INSULATION

Safety Controls for Hi-Pot Testing



TRIP-FREE RELAY CONTACTS, overload relay tripping and mechanical interlocks prevent false operation of this high-voltage test circuit

J. F. GRAY
Meter Instrument Tester
Central Power & Light Co
Corpus Christi, Texas

TO INSURE SAFETY in the application of the Silsbee method of testing potential and current transformers and in other insulation tests, interlocks and trip-free controls are applied in the circuit illustrated. Magnetic switching of the supply is arranged so that, before the circuit can be energized:

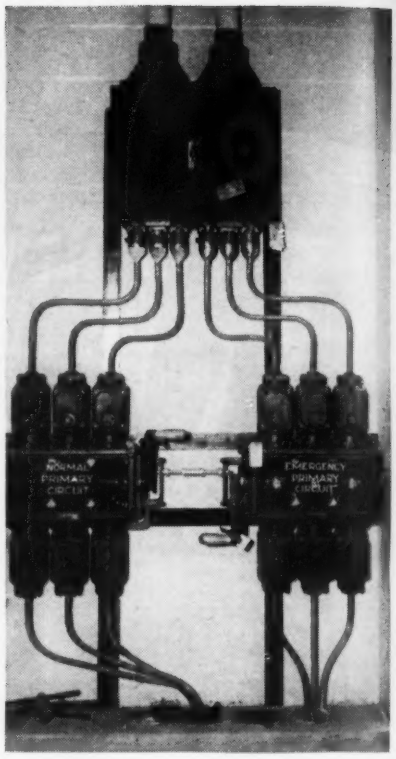
(1) The enclosure gate must be closed;

(2) The voltage regulator must be placed at the zero position;

(3) The regulator must be returned to the zero position before the circuit can be reclosed after the tripping relay has operated.

Setting Interlocks

Interlocks in the control switch must be properly set before the starting switch can be operated. Starting is by a momentary contactor and the relay can not be held closed against a fault. A safety gap in the high voltage circuit is set for 24 kv to prevent over-voltage. This safety feature is highly desirable.



FEEDER INTERLOCKS isolate idle circuit—In an eastern war plant, a duplicate 2,400-v feed was required to increase service reliability. Two circuits available for supplying both lighting and power transformers were brought from the main substation bus in cable to a segregation center in an isolated switch cell as shown. The circuits were connected to hand-operated primary switches mounted on steel framing. Short runs of cable were carried upward to a junction box. From here, one circuit ran in rigid conduit to a lighting transformer center, the other to a power transformer distribution center nearby. One circuit was operated as a normal primary and the other as an emergency primary. The operating handles on the switches were interlocked to prevent closing but one switch at a time. This enabled one circuit to be held in reserve.

Syn Motor Solves Crusher Drive Problem

POOR POWER FACTOR and wide voltage fluctuations often prevent good rock crusher operation. Motors, big enough to handle peak crushing loads, operate underloaded most of the time. Thus when crusher is fully loaded, the voltage fluctuates widely; when empty, the power factor slumps. A crusher plant licked this problem. Two motors are used. A 500-hp slip-ring unit starts the crusher; a 500-hp over-excited synchronous motor with 250 percent pull-out torque operates it. It wasn't always done this way. The primary crusher, handling ton-sized single rocks, was belted originally to a jack shaft. This shaft was driven from a direct-connected, 500-hp, slip-ring motor. When the crusher tackled big rocks, motor loads hit 1,200 hp, then fell to about 25 percent load and 50 percent power factor or less. Voltage surged violently. The motor control tripped out, killing the machine. The crusher, left full of rock, had to be emptied by hand, a time-consuming process.

A synchronous motor opposite the slip-ring unit on the jack shaft improved conditions. The slip-ring motor makes all starts. When normal speed is reached, the synchronous motor is brought on the line manually and the slip-ring switch pulled. But the slip-ring motor still acts as a balance weight. Power factor is held to 80 percent and voltage on the feeder is satisfactory. Complaints to the power company by the quarry

16,000-kva, 110,000 to 13,800 volts, water-cooled single phase, 60 cycle, Wagner Power Transformer.

Silent Servants at Bonneville

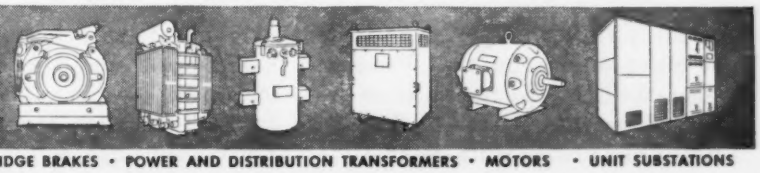
Power transformers are "silent servants" essential for the unfailing transmission of power so that factories, hospitals, schools and homes may have a continuous and dependable flow of electricity for every need. The Wagner transformers installed at the Bonneville Dam and at many other points along the 2700 mile high-voltage Bonneville-Grand Coulee system are giving unfailing service. Wagner power transformers are dependable because they are liberally designed with extra factors of safety, constructed of carefully selected and pre-tested parts, and are skillfully engineered, built, and tested.

Utility companies will find it to their advantage to consult Wagner on their next power transformer installation. Wagner transformers are built to maintain a reputation for quality established in more than fifty years of dependable service to the power industry. Users of Wagner transformers also profit by our quick, convenient, nationwide service facilities.

Any of our twenty-nine branch offices, located in principal cities, is ready to help you. These offices are manned by trained field engineers who will gladly give you the information you need in completing your next transformer installation. Write for Bulletins TU-180 and TU-181 on the complete transformer line. Address Wagner Electric Corp., 6456 Plymouth Avenue, St. Louis 14, Mo.

Consult Wagner Engineers on All Transformer Problems

Wagner Electric Corporation
EST. 1891



T47-5

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS

and other customers on the feeder have stopped. Formerly, the other customers on this feeder were adversely affected by low voltage, especially those whose electrical equipment included synchronous motors.

• • •

Use of Damper Windings on A-C Generators

VI*—POWER PULSATION

WILLIAM L. RINGLAND
Electrical Engineer,
Allis-Chalmers Mfg Co,
Milwaukee, Wis.

DAMPER WINDINGS contribute little to the operation of most diesel-engine-driven generators, despite the almost universal practice of requiring them on all such units. Although engine builders are held responsible for the successful parallel operation of their units, damping seldom enters the problem. The generator manufacturer is very rarely requested even to state what the damping torque will be. Nevertheless, dampers continue to be specified.

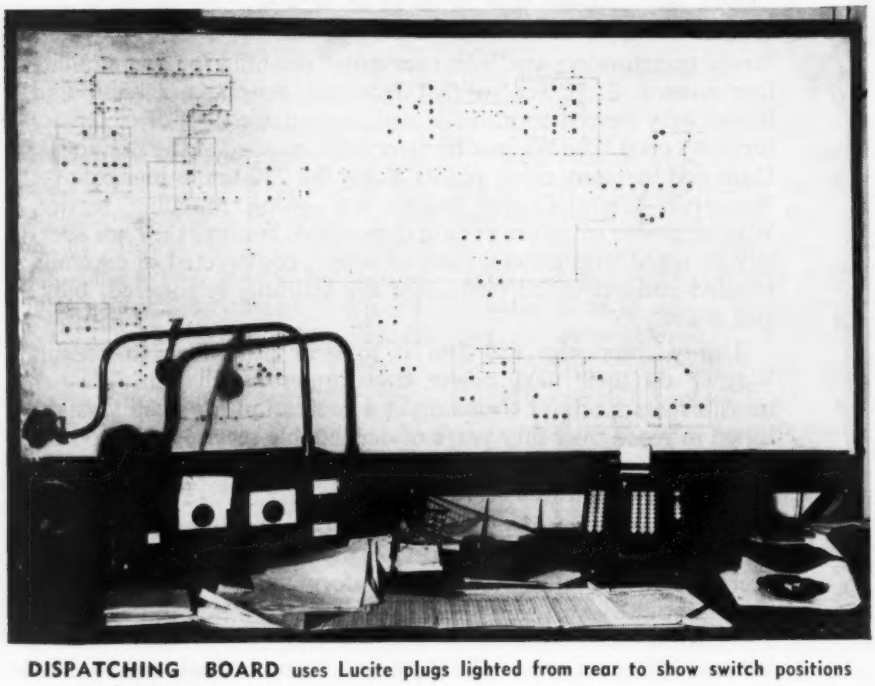
The source of power pulsation is, of course, the cyclic variation in engine torque. If all cylinders of a modern multi-cylinder engine were identical in performance, the torque variation would be sufficiently small and its frequency sufficiently high to eliminate it as a source of trouble in this respect with generator flywheel effects normally obtained. However, all cylinders of a diesel engine do not always develop equal torque. One cylinder differing in output from the others will cause a cycle of torque variations once per revolution for a two-cycle engine or once in two revolutions for a four-cycle engine. The magnitude of the fundamental component of this variation has been arbitrarily taken as ± 7½ percent of the average torque for some power pulsation studies.

The engine torque pulsations of a unit operating alone, that is, not in parallel with any other unit, will cause variations in angular velocity which will result in voltage variation and possible light flicker. The remedy is sufficient flywheel to limit these effects to acceptable values. The effect of a damper winding is neglible, and such effect as is present may be detrimental in this respect.

* This series began in ELECTRICAL WORLD, August 16, 1947, page 81.

• • •

Simple Dispatching Board Easily Constructed



DISPATCHING BOARD uses Lucite plugs lighted from rear to show switch positions on transmission system

ROBERT MOREAU, Chief Dispatcher, U. S. Bureau of Reclamation, Casper, Wyo.

THIS DISPATCHING BOARD indicates switch positions on the Wyoming-Nebraska-Colorado transmission system of the U. S. Bureau of Reclamation. Chief feature is its low cost.

It consists of a large single-line diagram of the system pasted on a board. Small holes are bored through at switch locations; red or green Lucite buttons are inserted in these. Fluorescent tubes on the back of the board furnish the illumination.

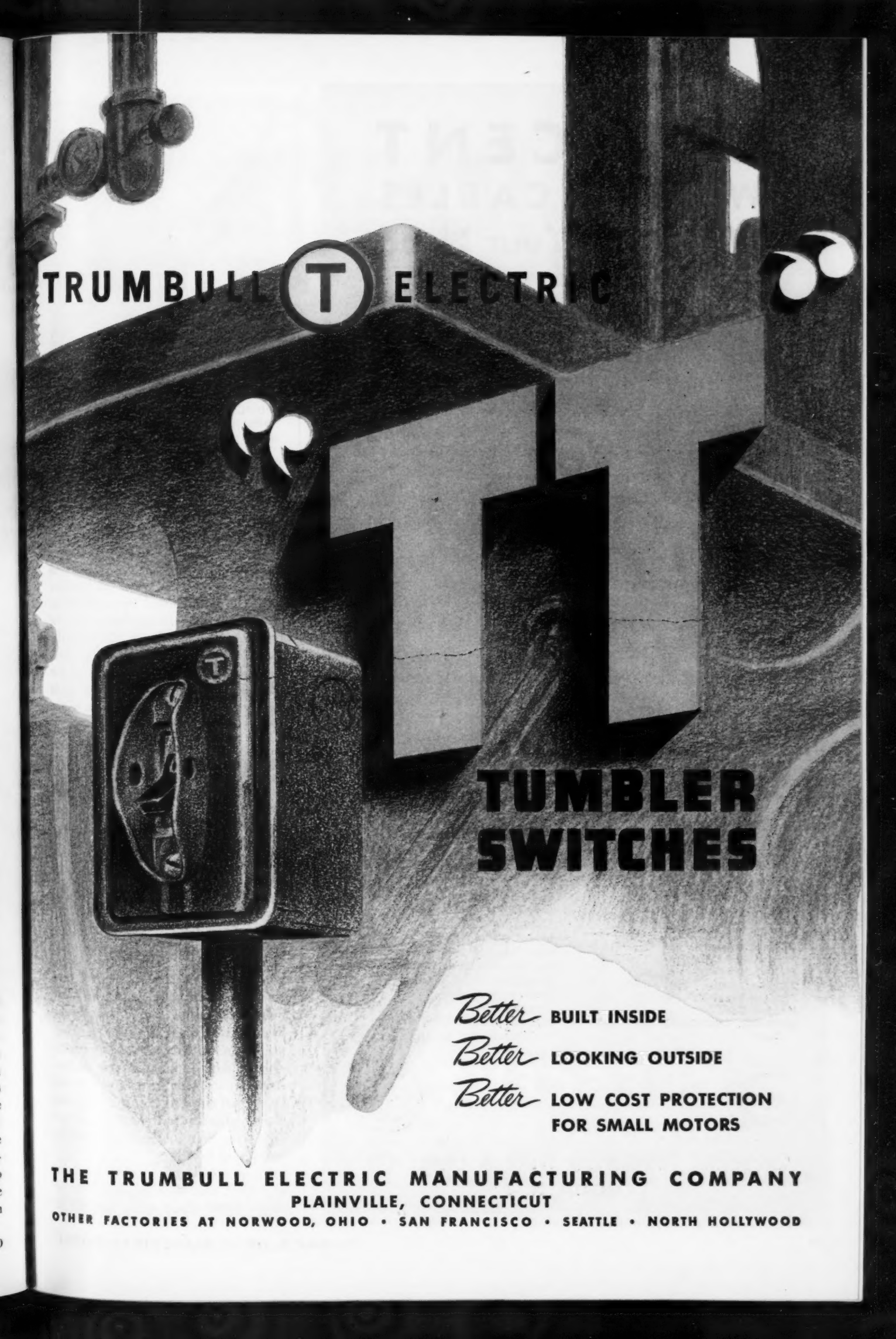
Meter Disk Punch

JOHN BOWLES
Metertester
Illinois Power Co
Granite City, Ill.

WITH SOME METERS such as the Sangamo H, HC, HFA, and HFS it is necessary to punch a hole in the disk to test them with a photoelectric tester; otherwise mirrors must be used. To test these meters it is much easier to punch the hole and then proceed as with any other meter.

A tool with a narrow nose serves as a punch to make a hole in a meter disk without removing it. An as-found-test can be taken without disturbing the accuracy of the run.

The punch is made from a pair of Westinghouse eyelet pliers. The eyelet die is punched out of each jaw of the pliers. The flange is then ground down to the same diameter as the die pin. The pin is then inserted in the hole of one jaw but opposite from the way it came out—that is, with the die part up inside the jaw. This leaves a perfectly round end to serve as the punch. The pin projects $\frac{3}{16}$ in. To hold the pin securely in the jaw, fill the hole with solder. Before soldering, the punch is closed so as to line the pin hole in with the opposite jaw. The band, shown in


TRUMBULL T ELECTRIC
TUMBLER SWITCHES
Better BUILT INSIDE
Better LOOKING OUTSIDE
Better LOW COST PROTECTION FOR SMALL MOTORS
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PLAINVILLE, CONNECTICUT
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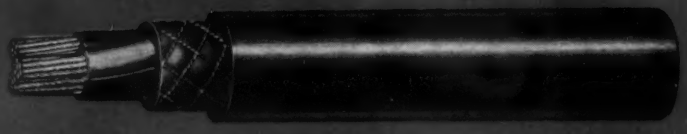
CRESCENT
WIRES & CABLES
Will Meet Your Need



Imperial Neoprene Portable Cords & Cables

Rubber Covered Wires & Cables

Varnished Cambric Lead Encased Cable

Parkway Cable, All Types

AND AMONG OTHER TYPES THE FOLLOWING:

ABC Armored Cable
Armored Ground Wire
Bare Copper Wire & Cable
Bell Wire
Brewery Cord
Control Cables
Fire Alarm Cable
Fixture Wires
Flexible Cords
Flexible Steel Conduit
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PERMACORD
Power Cables
Service Entrance Cable
Shipboard Cable
Signal Cable
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Welding Cable

CRESFLEX Non-metallic Sheathed Cable

CRESCENT
WIRE AND CABLE
CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

PUNCH PLIERS for making hole in meter disk

the illustration, is a flat piece of copper soldered in position. It is to prevent the pliers from closing too tightly and bending the disk in the type of meter that has a raised rim around the edge.

The punch pliers fit easily between the two magnets in front of the meter. The hole should be punched as close as possible to the outer edge of the disk and directly in line with the anti-creep slots. The tester light, when focused on the hole just back of the magnet, at the side of the meter, finds an opening to go straight down to the photoelectric eye.

•

Photo-Tube Control For Individual Street Lights

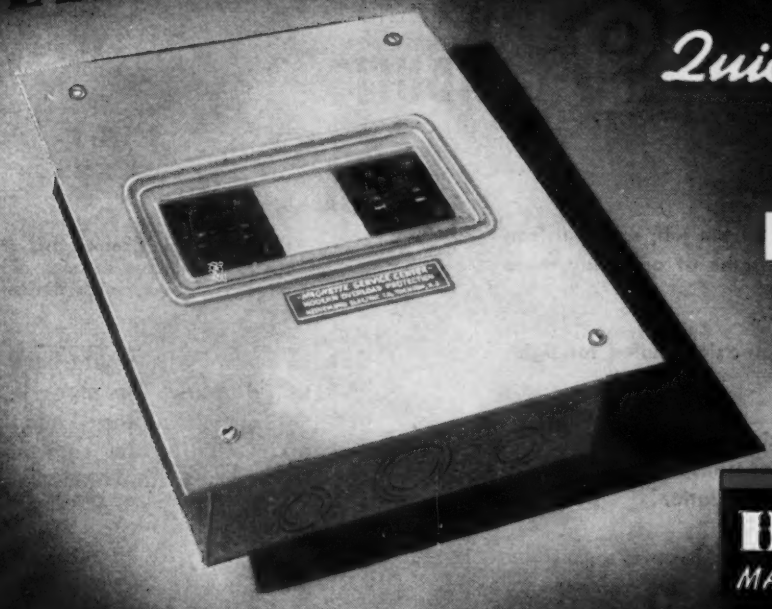
EARL BAUGHN,
Washington Water Power Co
Spokane, Wash.

A SOLUTION to the problem of controlling multiple street lights in areas outside cities has been found by the Washington Water Power Co. They use of one of the inexpensive photoelectric devices now on the market. Adoption grew out of the trouble and expense of resetting motor-driven time clocks after interruption to service of making the usual seasonal changes in burning hours.

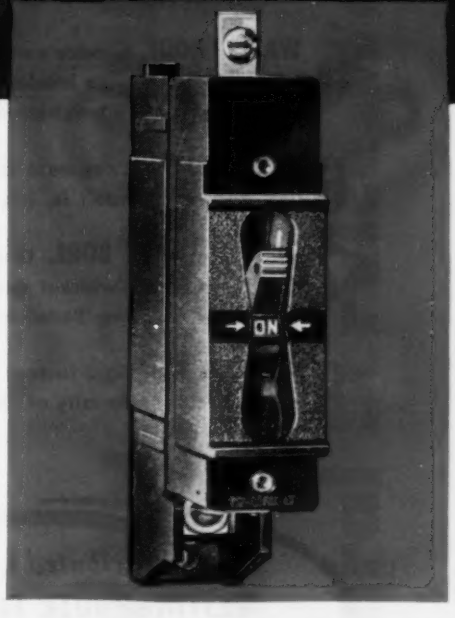
The photoelectric control is so inexpensive that it is applied even to single lights where more than 80 lb

HEINEMANN

"MAGNETTE" SERVICE CENTERS *for Quick, Convenient* CIRCUIT PROTECTION



HEINEMANN
MAGNETIC CIRCUIT BREAKERS



HEINEMANN "Magnette" SERVICE CENTERS consist of a strong steel housing containing from 2 to 6 protective devices. These housings have a baked-on aluminum finish over a rust-resistant coating. Service Centers with 2 or 4 circuits may be easily changed to accommodate 6 circuits by adding the proper breakers and bus bar connections. Service Centers are made for either surface or flush mountings (as shown above).

HEINEMANN Magnetic CIRCUIT BREAKERS installed in these Service Centers break the current *instantly* in case of sudden, dangerous overloads, but a magnetic-hydraulic time delay unit prevents unnecessary interruption of current on minor overload or inrush current.

A flick of the finger restores current, but if dangerous overload persists, the breaker will remain open, thus affording protection at all times.

EST. HECO 1888

HEINEMANN ELECTRIC COMPANY

103 PLUM STREET **TRENTON, NEW JERSEY**

BERMICO*
FIBRE CONDUIT

FOR SUREST CABLE PROTECTION---
SPECIFY BERMICO CONDUIT

1 **LIGHT.** Easily handled on the job; one man can carry several 8-foot lengths at once—lay more per working hour.

2 **TIGHT.** All joints are precision milled for tight, speedy, installations.

3 **STRONG.** Bermico Conduit is engineered to take the shocks and stresses of transport . . . the heavy loads imposed during installation.

4 **NO SPLIT COUPLINGS.** With Bermico's specially designed couplings, you end the expense—the loss of time required to replace broken couplings.

5 **WATER PROOF.** Bermico's water absorption factor is extremely low—its insulation factor extremely high, even under toughest conditions.

6 **ACID RESISTANT.** Resistant to soil acids and alkalies, Bermico Conduit is, itself, chemically inert.

7 **SMOOTH INSIDE BORE.** Quick and easy cable "pull throughs"—without danger of abrasions—when you're using Bermico *inspected* conduit!

8 **UNIFORM.** Four rigid factory inspections guarantee Bermico's uniformity of dimensions, specifications and quality.

distributed by
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

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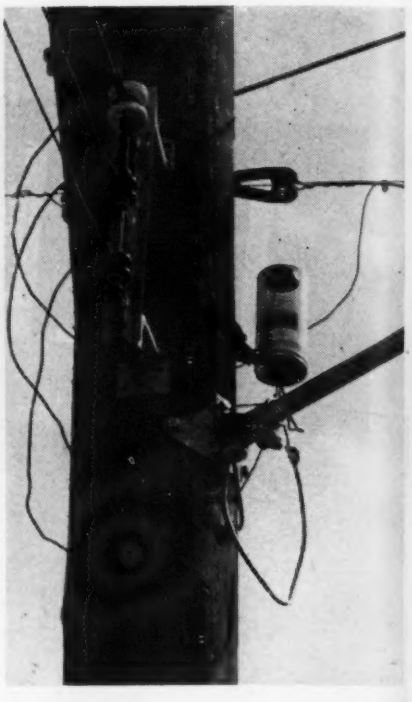
BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY



INDIVIDUAL photoelectric street light control eliminates expense of many resettings of time switch devices

of control wire would have to be run to group two or more lights. The "Sunswitch" unit used and the method of installation are shown in the accompanying illustrations.

•

Bottling Plant Conveyor Has Overhead Drive

MAXIMUM FREEDOM of product movement at the Boston plant of the Moxie Co from bottling to shipping departments is requisite. In this section of the production line a canvas belt 12 ft long x 14 in. wide is driven by a 1-hp, 440-v, 3-phase motor. The capacity of the bottling section is approximately 15 cases of 24 bottles each (7-oz size) per min. This 1,140-rpm motor is mounted on a 9-in. x 12-in. x $\frac{5}{16}$-in. steel base plate. It drives the conveyor through a chain belt and speed reducer.

The unit is supported by a frame of four steel angles 5 ft high with 2-in. x 2-in. x $\frac{3}{16}$-in. sections. These have 90-deg turns at the bottom to provide attachment to bolts seated in the tile flooring as shown. The attachments are of $1\frac{1}{4}$-in. x $\frac{1}{2}$-in. strap-iron. Cross braces of 2-in. x 2-in. angle-iron stiffen the vertical frame members.

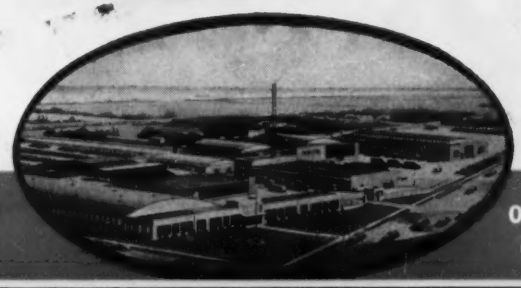
Series 25M (½ ton chassis)
and 35M (¾ & 1 ton chassis)
Meter Installation & General Service Body

ALL-STEEL

POWERS

PUBLIC UTILITY BODIES

EMERGENCY or ROUTINE
Meter Installation and
General Service Work



LINE BODIES • SERVICE BODIES • POLE TRAILERS • SPECIAL EQUIPMENT

McCABE-POWERS AUTO BODY CO., 5900 N. BROADWAY, ST. LOUIS 15, MO.

Over 75 years experience!

THE SMALL EXTINGUISHER..
WITH THE *MIGHTY PUNCH!*

FOR FIRE HAZARDS THAT DO NOT DEMAND LARGER EQUIPMENT . . .

The new ANSUL 4 Dry Chemical Fire Extinguisher has fire stopping effectiveness far in excess of any other extinguisher of comparable size. Its compact size makes it ideal for locations where space is limited. The ANSUL 4 is easy to use . . . easy to recharge on-the-spot . . . and again ready to

STOP FIRE FASTER!

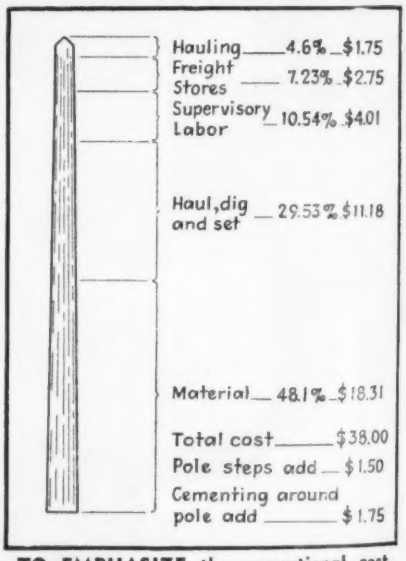
MADE BY THE MANUFACTURERS OF ANSUL-DUGAS DRY CHEMICAL FIRE EXTINGUISHERS, MODELS 20, 30, 150A AND 350A.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

FRAME supporting drive-motor bridges conveyor to clear floor and enable cases to traverse open pathway to counters and gravity conveyor to shipping department

Push-button control is provided for the motor. A clearance of about 4 in. was laid out between the drive supporting frame and the belt supports on each side of the production line. The frame structure occupies only about 4 sq ft of the floor space below the conveyor line.

Pole Cost Charted



TO EMPHASIZE the proportional cost of procuring and setting a unit pole, a New England utility plots the component items of expense against an elevation as shown. In the case shown, a Class 4, 35-ft hard pine creosoted pole cost was analyzed. The total pole cost was $38, or $41.25 including pole steps ($1.50) and cementing ($1.75). The data were compiled in 1946, based on work orders issued in 1945. The plot enables the engineering department to re-check the relative importance of material expense, excavation, haulage and setting, supervision and freight.

ROCKBESTOS A.V.C.

Gives Trouble-Free Performance in Temperatures up to 230°F.

The cables in the photo above have to take a continuous "Turkish Bath" day after day, month after month. They're getting a heat treatment that can cost plenty in rewiring and expensive maintenance unless the insulation is built *specifically* for such hot-spot installations.

It's in trouble-making locations like these that Rockbestos A.V.C. wires and cables protect vital circuits and reduce expense by giving *extra* years of service. Their *permanent* insulation outlasts other types because the impregnated asbestos withstands continuous operation under temperatures ranging up to a maximum of 230° F. Ample moisture resistance guards against failures caused by heating and cooling cycles in conduit installations. And the impregnated asbestos braid, like the insulation, won't deteriorate with age and won't rot or bloom when exposed to corrosive fumes, grease or oil.

Maintenance-reducing Rockbestos A.V.C. constructions in 600 to 5000 volt ratings include single and multi-conductor power cables, switchboard and lighting wires, control cables and other National Electrical Code types. Write for recommendations or samples.

ROCKBESTOS PRODUCTS CORPORATION
220 NICOLL ST., NEW HAVEN 4, CONN.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE—CODE TYPE AVA
(Max. operating temperature 230°F.)

The cable illustrated and similar types rated up to 5000 volts assure trouble-free performance in hot locations with this construction:

- A tough impregnated asbestos yarn braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
- Heat, flame and moisture resistant impregnated felted asbestos outer insulating wall won't dry out, crack, flow or rot.
- Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
- Inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.
- The conductor is perfectly and permanently centered in helically applied non-flowing insulation that helps provide greater current carrying capacity.

One of the 125 different wires, cables and cords designed by Rockbestos to meet severe or unusual operating conditions.

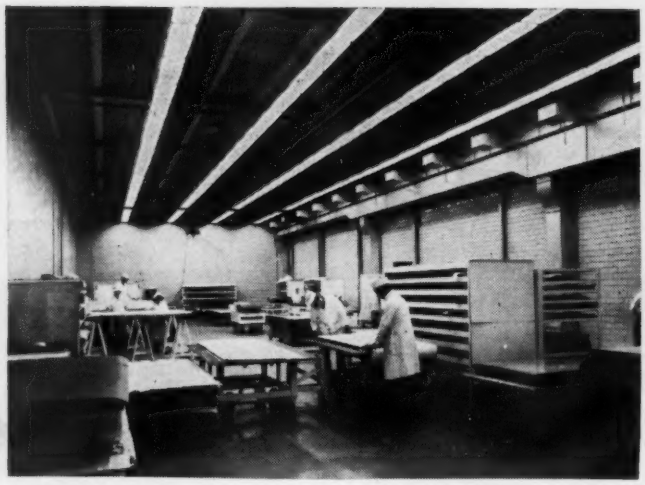
ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

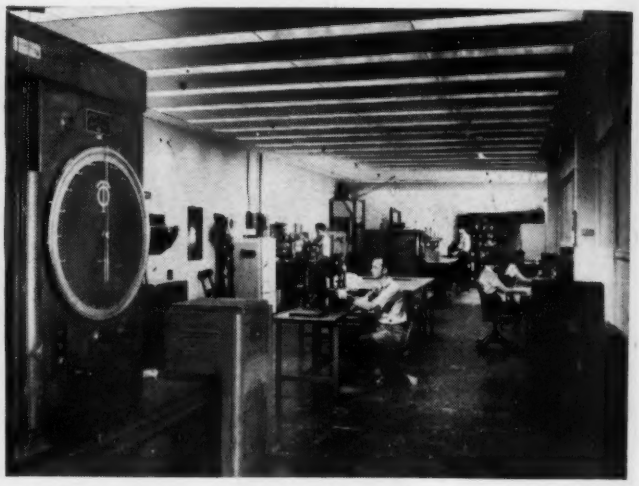
NEW YORK BUFFALO CLEVELAND DETROIT CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND

LOAD BUILDING

Modern Lighting for Manufacturing



UNIFORM light intensity is provided in this functional build-up department by the exclusion of all natural daylight. Continuous fluorescent troffer units provide 48 ft-c in this area



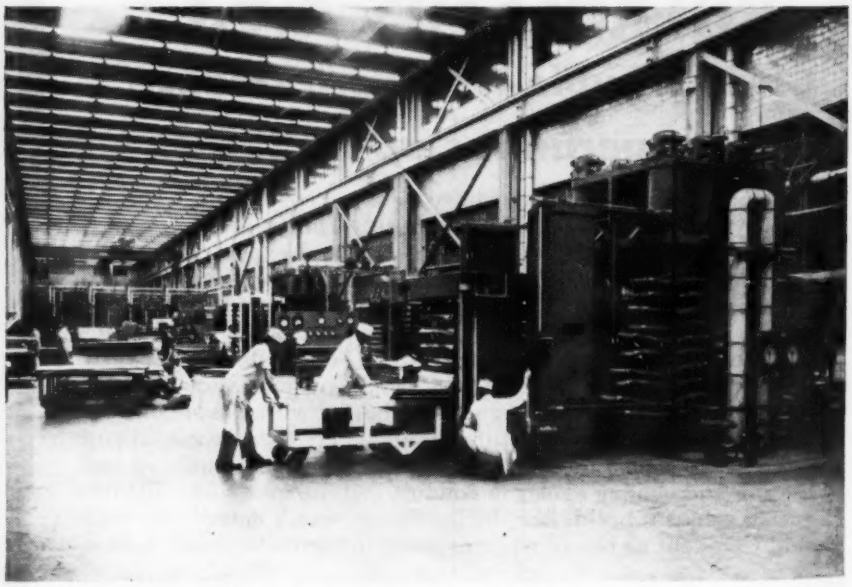
OFFICE and laboratory lighting by continuous fluorescent troffer units. Lights are mounted flush with hairspun fiberglas mats in suspended acoustic ceiling

FLUORESCENT troffer lighting, installed in General Electric's Laminated Plastics Plant at Coshocton, Ohio, provides over 45 ft-c in all manufacturing areas. The lights are installed in continuous and semi-continuous rows. Fixtures in the high bay are mounted at a height of 34 ft and spaced on 8-ft 6-in. centers. Those in the general plant area are mounted on 10-ft 3-in. centers, 20 ft above the floor.

The office building is equipped throughout with continuous open fluorescent troffer units. These are 3 ft apart and at a height of 10 ft. They provide 60 ft-c and are mounted flush with the hairspun fiberglas mats used in the suspended acoustic ceiling.

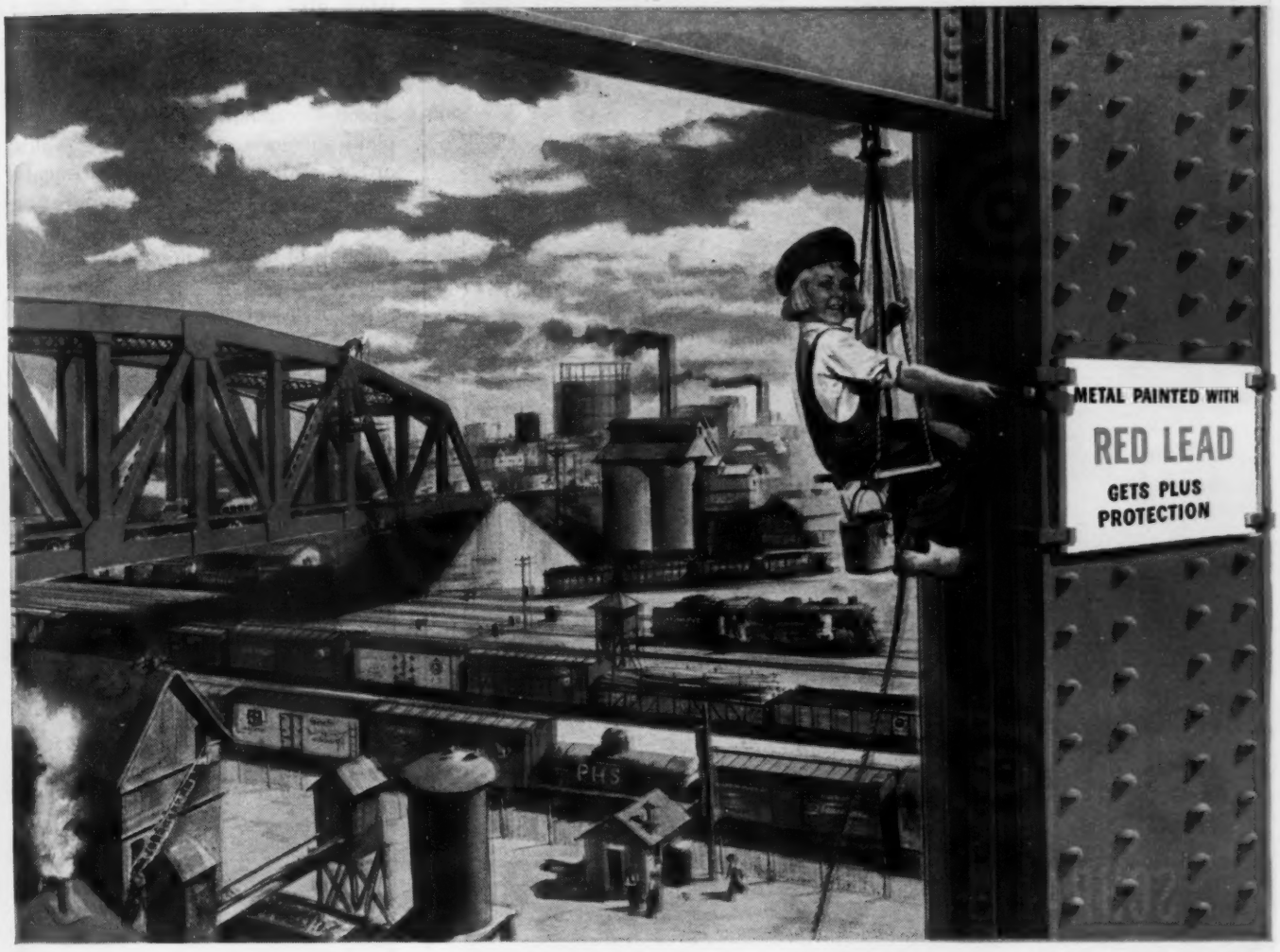
Facilities for power distribution are concentrated in the trusses. Over 3,500 ft of interlocked armor cable have been suspended from the top chord by pipe brackets. This cable is equally divided between 5-kv and 600-v sizes.

Power is supplied to the two main substation transformers of 5,000-kva capacity at 34,500 v and reduced to 4,160 v. Four unit substations of 1,000 kva are located in the manufacturing plant. Two of 750 kva serve the boiler house and varnish building. The large units deliver 480-v, 3-phase power to an overhead bus distribution system. This system comprises nearly a half mile of plug-in and feeder lines, ranging from 600-amp to 1,000-amp capacity. The smaller transformers are mounted on special mezzanines suspended from the trusses.



CONTINUOUS ROWS of fluorescent troffer units flood working area with shadowless light. Luminaires are mounted on 8-ft 6-in centers at a height of 34 ft. 45 ft-c are provided

Ninety tons of refrigeration are used in cooling the 18, 450 sq ft of



How RED LEAD stops Electro-chemical Action ...basic cause of Rusting

Modern science reveals many reasons *why* Red Lead has earned its place as the "standard" metal protective paint.

One very basic factor is Red Lead's ability to halt electro-chemical activity–the fundamental cause of rusting.

In this electro-chemical action, weak currents are generated, because of chemical and physical differences in the metal, as well as local differences in environment. As a result, the iron goes into solution and rusting is promoted.

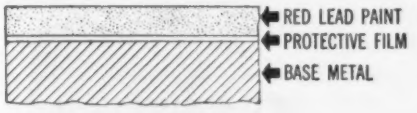
These electro-chemical conditions are always present; but Red Lead eliminates their harmful effects.

Here's how: Red Lead possesses unique properties which enable it rapidly to convert the iron solubles into stable compounds. This forms a tightly adherent, protective film located at the interface of the metal and the Red Lead coating (see diagram).

This film, so thin it cannot be seen by the eye, is in direct contact with the metal. It effectively inhibits electro-chemical action, and the consequent corrosion of the metal.

Naturally, for *continued* protection, the film must remain unbroken. Here again, in the same way, Red Lead heals any small breaks in the protective shield due to abrasive action or other causes.

Thus, the metal remains in a rust-inhibited condition as long as Red Lead coats the surface.



The Film that halts corrosion: *This diagram shows the protective shield, located at the interface of the metal and paint film. The formation and continuous maintenance of this film by Red Lead stops electro-chemical action...inhibits the metal from rusting.*

* * *

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including many of the fast-drying resin types.

Specify RED LEAD for ALL Metal Protective Paints

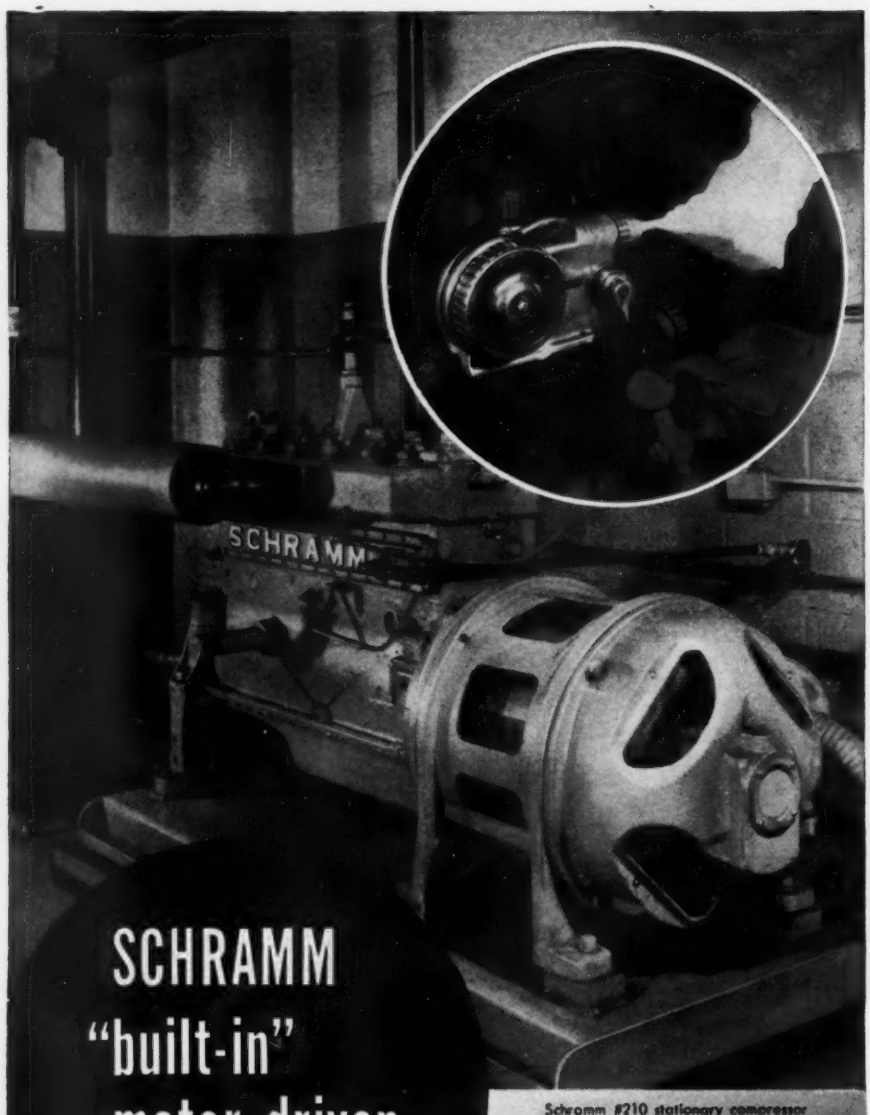
The rust-resistant properties of Red Lead are so pronounced that it improves any metal protective paint. So, no matter what price you pay, you'll get a better paint if it contains Red Lead.

* * *

The benefit of our extensive experience with metal protective paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; St. Louis 1; San Francisco 10; Boston 6, (National Lead Co. of Mass.); Philadelphia 7, (John T. Lewis & Bros. Co.); Pittsburgh 30, (National Lead Co. of Pa.); Charleston 25, W. Va., (Evans Lead Division).

DUTCH BOY
Reg. U. S. Pat. Off.
RED LEAD



SCHRAMM "built-in" motor driven compressor

Schramm #210 stationary compressor operating metallizing gun and other pneumatic tools in the plant of the Metallizing Engineering Company, Long Island City, New York.

Reclaiming defective castings . . . a process developed to enable foundries and machine shops to effect a positive repair of defective aluminum castings. May also be used for reclaiming bronze, grey iron, malleable iron, as well as steel castings.

This is only one of the hundreds of different applications of compressed air for industrial and manufacturing plants as furnished by the Schramm heavy-duty, continuous service, built-in motor or "V" belt drive compressors ranging from 2½ to 600 cu. ft. displacement.

Write for catalog 45A.

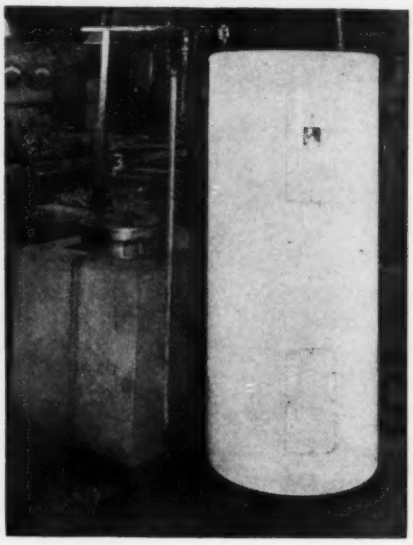
SCHRAMM INC.

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

office area, where four air changes per hour are provided. Movable steel partitions have been used throughout this building, the second floor of which accommodates the offices of the plant manager and engineer; sales, order, and accounting departments, and drafting room. The engineering department and laboratory occupy one-half of the first floor, and production planning, personnel, and plant superintendent share the other.

•

Electrotypes Speeded With Water Heater



DOMESTIC water heater speeds up production in electro-type shop

F. C. HESCH, Jr
Duquesne Light Co
Pittsburgh, Pa.

A PRODUCTION BOTTLENECK was eliminated by the installation of a 52-gal electric water heater at the Fort Pitt Electrotype Co, 530 Duquesne Way, Pittsburgh, Pa. In the making of electrotypes, hot water is used to separate the copper shell from the tenaplate mold. The daily 60 to 70 gal of hot water for this job was formerly furnished from the building supply. Oftentimes production was held up because of varying temperatures of the water, at best only 120 F.

The problem was solved by the installation of domestic-type electric water heater. Water at 170 F from it is available at all times. Because this adequate supply of hot water is assured, production schedules can be arranged to obtain maximum plant efficiency. Additional reasons for the selection of the electric water heater were its reliability and because it could be located without regard for a

4 BIG REASONS

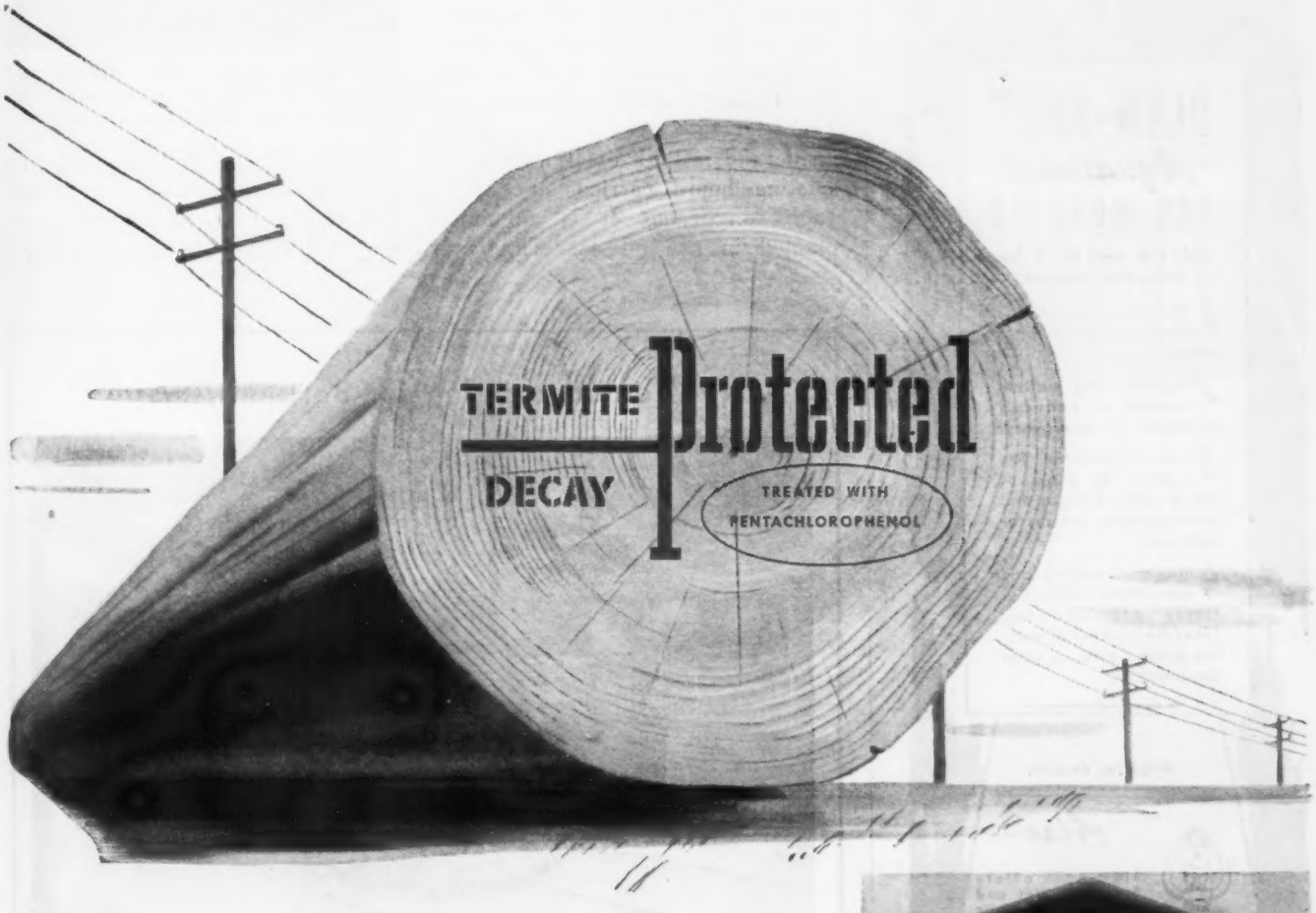
behind the switch to

ANOTHER DOW PRODUCT

penta

-chlorophenol

1. You know what you're getting with Pentachlorophenol—same today—yesterday—tomorrow.
2. You can duplicate service records exactly. Treating solution is scientifically controlled.
3. You get *full strength* preservative—measured *dependable* preservative action.
4. You get a *clean* treatment—poles are easy to handle—easy to work on.

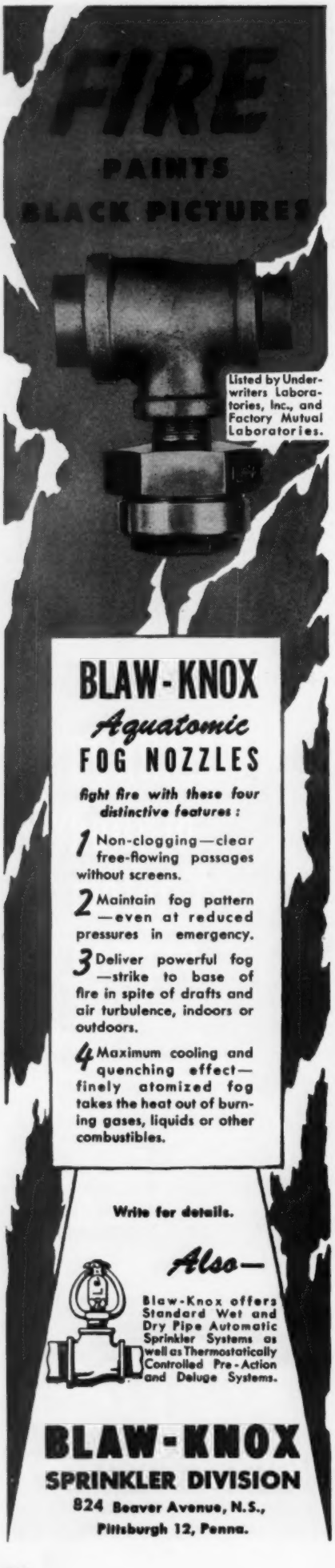


For further information, talk to your treater or call on Dow.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE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Aquatomic
FOG NOZZLES
fight fire with these four distinctive features:
1 Non-clogging—clear free-flowing passages without screens.
2 Maintain fog pattern—even at reduced pressures in emergency.
3 Deliver powerful fog—strike to base of fire in spite of drafts and air turbulence, indoors or outdoors.
4 Maximum cooling and quenching effect—finely atomized fog takes the heat out of burning gases, liquids or other combustibles.
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Also—
Blaw-Knox offers Standard Wet and Dry Pipe Automatic Sprinkler Systems as well as Thermostatically Controlled Pre-Action and Deluge Systems.
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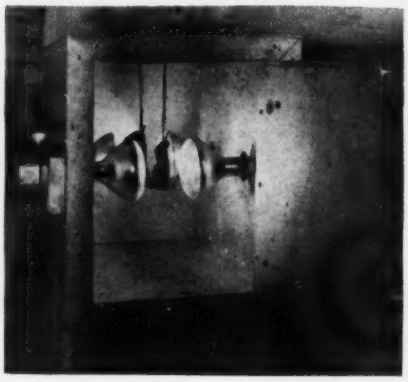
824 Beaver Avenue, N.S.,
Pittsburgh 12, Penna.

flue connection. It has a connected load of 2,500 w—a 1,500-w element at the top of the tank and a 1,000-w at the bottom. A control switch permits the operation of only one element at a time so that maximum demand from the water heater is 1.5 kw.

• • •

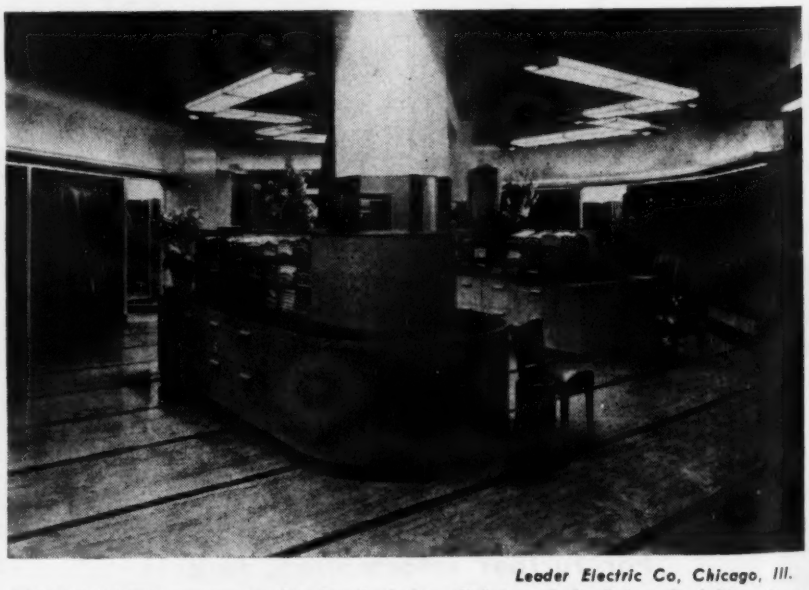
Cloth Swatches Dried in 3 Minutes by Infrared

FIFTEEN MINUTES per test sample were formerly required to dry cloth by steam coils at Killingly Worsted Co plant, Elmville, Conn. Speedy drying is vital since color must be checked while the bolt of cloth is passing through the dye vats. By building the oven illustrated and equipping it with four 250-w, infrared lamps, the drying time was cut to 2.5 to 3 min. The lamps are mounted in pairs facing each other and are 2.75 in. apart. The "swatches" or samples are hung between the lamps on a T-clip supported through a slot in the oven top. The oven is 14 in. x 17 in. x 23 in. inside and is built of ¼-in. thick insulating board carried on a 1-in. angle-iron frame. It is aluminum painted inside and out. The lamp sockets are porcelain, and are mounted on the outside for cooling. Connecticut Light & Power Co cooperated in solving this problem.



IN THIS simple oven, samples of worsted are dried five times as fast as before infrared lamps were employed

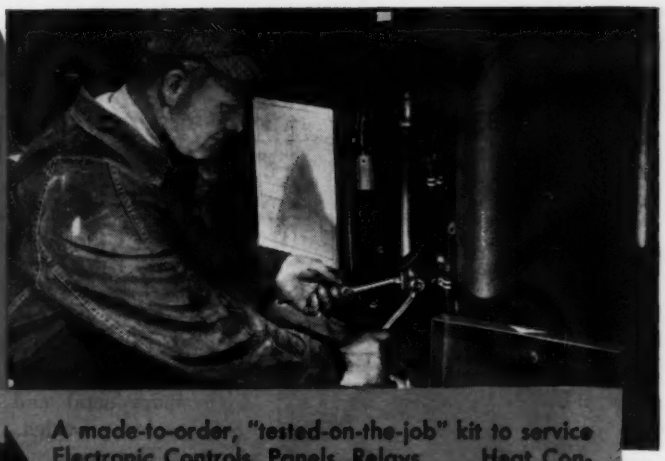
Patterned Lighting for Better Display



Leader Electric Co, Chicago, Ill.

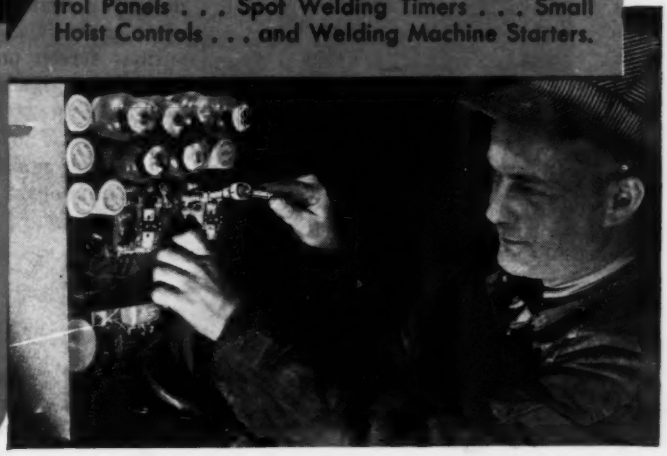
ORIGINALITY appears in this detail of the relighting of the Robert S. Atkins store in San Francisco. Fluorescent fixtures, mounted in an unorthodox pattern, light this irregularly-shaped salesroom with a pleasing effect. The new lighting raised the average intensity throughout the store from around 10 ft-c to 100. In the spotted areas lighted by the downlights at fixture ends, the intensity is 175 ft-c. The installation, comprising a total of 252 fixtures, was made by the Beacon Electric Co.

Snap-on Basic ELECTRONIC CONTROL SERVICE TOOL KIT



A made-to-order, "tested-on-the-job" kit to service Electronic Controls, Panels, Relays . . . Heat Control Panels . . . Spot Welding Timers . . . Small Hoist Controls . . . and Welding Machine Starters.

. . . cuts "down-time" to a minimum
. . . speeds maintenance . . . because
you always have the right tool
at the right time



This complete 51-pc. kit with Handy Hold-all Box for only **$48.47**

Actually tested in the shops where "down-time" must be held at an absolute minimum, this kit has proved its value over and over again. It contains all the basic tools you will need . . . *and they're Snap-on tools,* built and sized to precision tolerances with the *feel* and *balance* that gives you fast nut-turning efficiency. Check the complete list at the right . . . tear out coupon and mail today.

SNAP-ON TOOLS CORPORATION
8108-K 28th AVENUE • KENOSHA, WISCONSIN
International Division: Kenosha, Wisconsin, U. S. A.

Including . . .
- 1 Midget Set 1/4" drive
  - Ratchet, Sliding Tee
  - Nut Spinner, Flextation
  - Plastic Grip Handle
  - Universal Joint
  - 2" and 6" extension
- 8 Hex. Sockets 3/16" to 7/16"
- 8 Deep Hex. Sockets 3/16" to 7/16"
- 3 Square Sockets, 1/4", 5/16", 3/8"
- 4 Dwarf Boxockets 5/16" to 3/4"
- 8 Ignition Wrenches 7/32" to 3/8"
- 1 9 1/4" Screw Starter
- Tungsten Ignition File
- 6" Mill Bastard File
- 5" Gripper Pliers
- 6" Diag. Cutter Pliers
- 6" Needle Nose Pliers
- 3 Screw Drivers
  4" Offset, 1 1/2" and 2 1/2" Stubby, plus a 3" and 4" blade.
- 1 Red Hold-all Box

Please send me the $48.47 Electronic Control Service Kit. No. TM-151.
I am enclosing . . .

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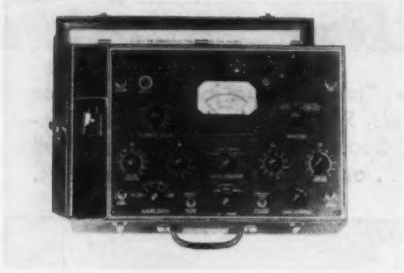
NEW EQUIPMENT



Tubechecker

A NEW proportional mutual conductance tubechecker, known as Model 798 Type 5, has been announced by the Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J. The instrument not only tests all receiving tubes but also handles voltage regulator tubes and low power thyratrons. It is mounted in an aluminum case and weighs 23 lb.

Using a new method of tube testing —the differential frequency system— the new tubechecker provides proportional mutual conductance readings under conditions which closely resemble actual operation. "Good-Bad" readings also are provided. Sixty-cycle a-c potentials are used on tube elements, thereby approaching the zero plate load conditions most desired for mutual conductance tests. A separate internal 5-kc signal is applied to the control grid, and the resulting plate component of the high-frequency signal is measured on a rectifier meter.

Since the normal plate current of the tube does not pass through the meter circuit, all types of tubes can be tested without overloading. Three signal voltages of only 0.75/1.5/3 v provide mutual conductance ranges of 12,000, 6,000 and 3,000 micromhos, without overdriving, or tube damage which might result from use of a higher signal voltage. A hot neon test is provided for checking leakage between tube elements.

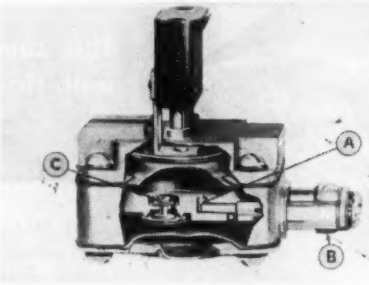
In addition this instrument will indicate the static and regulating characteristics of voltage regulator tubes such as the VR105 and VR150, and will test thyratrons 884, 885, 2A4, 6D4, 2050, 2051 and similar low-power tubes. Grid bias, plate voltage and meter sensitivity are independently adjustable from separate controls. Also, a flexible switching circuit provides for testing of new tubes as they are brought out, with one spare octal and one spare miniature socket provided.

The power supply, of conventional design, permits use of four different plate potentials, in combination with various screen potentials, to eliminate possible overloading of diodes, battery type tubes, etc. The Model 798 operates on 105/125 v, 50/60-cycle current. Line voltage adjustments can be instantly and continuously made during the testing of a tube.

•

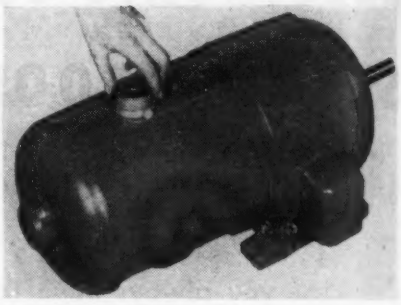
Pneumatic Timers

WIDE-RANGE time limit acceleration, unaffected by normal variations in ambient temperature and voltage conditions, is provided by pneumatic timers, a product of Square D Co, Detroit, Mich. Danger of timing error as the result of friction between surfaces or moving parts, mechanical wear or foreign material on magnet surfaces, has been completely eliminated.



Air is transferred from lower chamber to upper chamber through metering orifice (A). Rotation of knurled wheel (B) gives wide range of adjustment. The air returns through valve (C) for instantaneous reset. Timers may be coupled to contactors or actuated by separate magnets.

Pneumatic-time acceleration permits motors to be brought to speed quickly and smoothly, regardless of load conditions. Operators become "tuned" to accelerating speeds and are better able to accustom themselves to the response of several different motors operated in sequence, as the result of uniform adjustment.



Adjustable Speed Motors

A NEW LINE of Tri-Clad brush-shifting adjustable-speed induction motors, Type ACA, has been announced by the Motor Divisions of the General Electric Co, Schenectady, N. Y. Available in ratings from 3 to 50 hp (220, 440, and 550 v), the new motor features stepless speed adjustment over a 3:1 ratio by simply turning a dial. The entire unit, with the exception of the starter control, is self-contained in a housing only a little larger than that for a constant-speed motor of a comparable rating.

Remote speed control can be accomplished by use of a flexible cable shaft up to 10 ft from the motor. For complete remote control, a small pilot motor can be used to drive the speed-control mechanism. Applications include driving textile machinery, draft fans, stokers, small paper machines, wire drawing machines, flat-work ironers, dough mixers, kilns, and pumps.

Uniform cooling with low intake velocity is provided by double-end ventilation. Over-load protection and limit switches to insure proper starting are built into the motor. The standard frames (225 to 505) have NEMA mounting dimensions. For resistance to oil and heat aging, Formex wire stator windings are used. A cast-iron bearing enclosure affords protection from moisture, dust, and dirt.

The motor is rated on a constant torque basis. It will carry full-load torque at rated current and frequency without exceeding a temperature rise of 40 C on high speed or 50 C on low speed, measured by a thermometer on the windings. Power factor is high when the motor is running at high speed. At synchronous speed, it is about the same as with a squirrel-cage induction motor of similar rating.

For intermittent use, speeds below

FEATURES THAT ARE RESPONSIBLE FOR SERVICE RECORDS EVERYWHERE

1. Bushings, properly sized and spaced, are oil filled, brown glaze, wet process porcelain with spade type terminals.
2. Core design provides double usual cooling area; is mechanically strong.
3. Rigid supporting structure assures long life and trouble-free operation.
4. Moisture completely removed from coils by preheating, vacuum impregnation with special varnish and baking.
5. Flashover protection provided by treated press board, varnished cambric, and insulating tubes.
6. Treated fibre spacers placed radially in vertical columns permit free flow of oil to all parts of coils.
7. Unique spring construction on coil end braces permits slight movement of coils under abnormal load without damage and takes up any slack due to coil shrinkage.
8. Ample clearance between high voltage winding and core prevents flashover.
9. Specially developed gasket prevents leakage of oil or entrance of air.
10. Welded jack bosses assist in handling.

● **In addition to special features, Standard offers you versatile engineering and flexible production facilities. Many of America's leading utilities have made full use of this Standard service to obtain design, construction, and operating characteristics which are exactly to their own liking. You will find it to your advantage, just as others have, to know what makes Standard Transformers efficient, dependable, and especially adaptable to your specific needs. There's a Standard representative in your district — write us today to have him tell you more.**

Standard Distribution Transformers are designed and built in full accordance with industry standards, and have additional features that insure long life and trouble-free operation.

REPRESENTATIVES IN PRINCIPAL CITIES

THE STANDARD TRANSFORMER COMPANY

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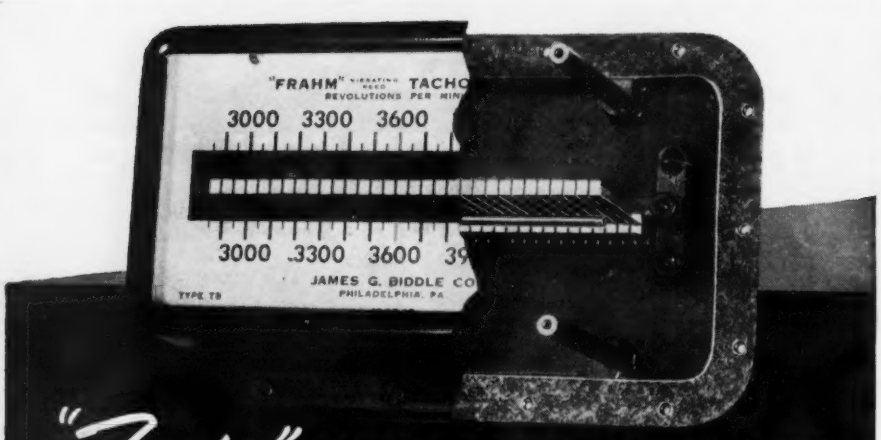
class of service

MAKERS OF POWER, DISTRIBUTION, INSTRUMENT STREET LIGHTING AND TESTING TRANSFORMERS OIL, ASKAREL OR AIR COOLED



"Frahm" RESONANT REED TACHOMETERS

Check THESE ADVANTAGES

- **ACCURATE,** because the tuned reed is a natural resonant indicator.
- **DEPENDABLE,** because permanent calibration is a natural characteristic of tuned reeds.
- **STURDY,** because there are no delicate pivots, jewels or moving parts.

and these . . .

EASY-TO-READ vibrating reed-tips form a clearly defined pattern.

LITTLE MAINTENANCE is a result of simple, sturdy construction.

LOW INPUT POWER is sufficient to actuate the reed comb.

OPERATE IN ANY POSITION without affecting accuracy.

ORDINARY ROOM TEMPERATURE VARIATIONS HAVE LITTLE EFFECT on calibration.

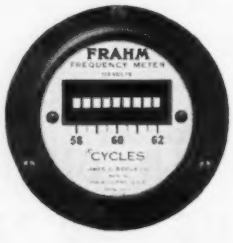
OPERATE WITHOUT DIRECT CONTACT with moving parts under test.

EASY TO OPERATE . . . may be held against or mounted on machine.

Frahm Resonant-Reed Tachometers in round, rectangular and miniature types are available in ranges between the limits of 900 and 100,000 rpm or vpm. Made for permanent mounting on turbines, generators, motors, blowers, centrifugal pumps, diesel-electric installations, etc. Made also in hand types for a wide variety of uses. Write today for Bulletin 1810-W.

"FRAHM" Resonant-Reed FREQUENCY METERS

. . . operate on the same unique principle as Frahm Tachometers except that reed vibration is produced electrically instead of by direct mechanical contact. Available in switchboard, miniature and portable types for ranges between 15 and 500 cycles per second. To meet special requirements, we are equipped to build instruments for measuring frequencies as high as 1400 cps. For complete information write today for Bulletin 1770-W.



JAMES G. BIDDLE CO.

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

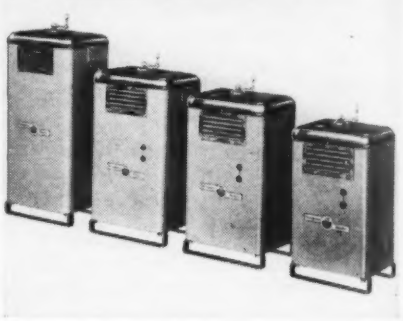
minimum rated may be obtained by adding secondary resistance. Plugging is possible by the same means. The motor is reversible for short periods of time by reversing two power leads.

Convenient inspection plates may be removed for inspection of brushes and brush-shifting mechanism. The motor may be greased while in operation. All necessary inspections may be performed without removing any operating parts.

•

Low Voltage Welder

A NEW and smaller designed Flexarc industrial line of a-c welders is available from Westinghouse Electric Corp,



East Pittsburgh, Pa. Features are a streamlined case and a well arranged interior with reactor and transformer built around high-permeability Hipersil steel cores.

Known as "The 65 Line" for the open circuit voltage, these new welders are stated to have high arc stability in the lowest as well as the highest current ranges of the five output ratings—200, 300, 400, 500 and a duplex 300/600 amp.

Built-in low voltage control is said to assure high operating efficiency in the low current range; built-in capacitors are to assure a high power factor and economical full rated operation.

Natural ventilation, movable core reactor operated by single ball crank current-adjusting mechanism provide minimum maintenance and attention. To reduce over-all size and maintain uniformly high operative efficiency, fan cooling is employed in the 500-amp ratings.

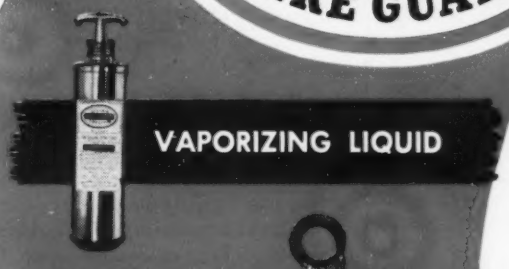
Heavy duty castors for portability and strap skid mounting on stationary units add to the welder serviceability.

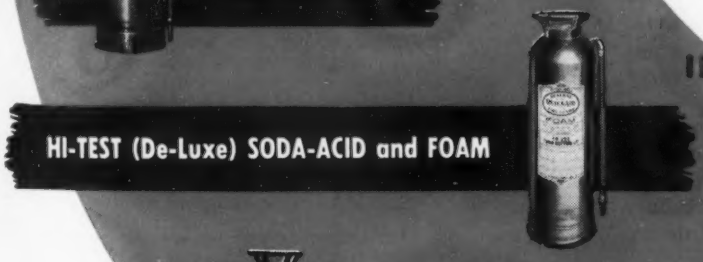
•

Motor Starters

DEVELOPMENT of new Bulletin 4051 automatic motor starters is announced by the Ward Leonard Electric Co, Mount Vernon, N. Y. These starters are of the non-reversing autotransformer type designed for use with single-speed,

There's Nothing Quicker than GENERAL QUICK AID FIRE GUARD for Fighting Fire



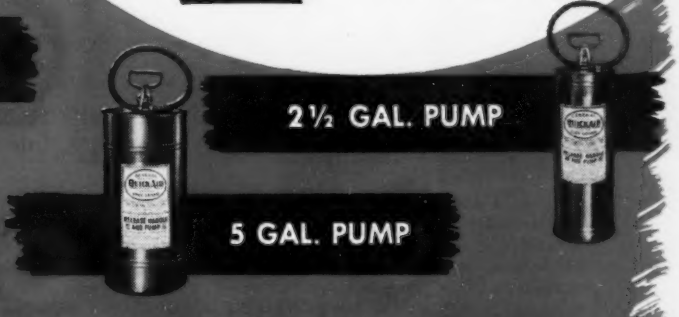


Seconds count in fire fighting. Use QUICK AID FIRE GUARD to save precious seconds.

QUICK AID FIRE GUARD gives you dependable *quick action* in a fire. Operation is simple and sure. QUICK AID FIRE GUARD is the only extinguisher with patented Safety Phlare Pump. This exclusive feature assures positive operation, even after long disuse.

QUICK AID FIRE GUARD is available in vaporizing liquid, carbon dioxide, foam, soda-acid, or non-freeze type.

IF IT'S GENERAL IT'S DEPENDABLE



Wherever you are, there is a GENERAL dealer nearby. Without obligation, he will help you select the right QUICK AID FIRE GUARD for every fire hazard. Look for the GENERAL trade-mark in the classified section of your phone book, or drop a line to GENERAL in Detroit.

THE GENERAL DETROIT CORP.

DETROIT 7, MICHIGAN

NEW YORK • PHILADELPHIA • ATLANTA • CHICAGO • DALLAS

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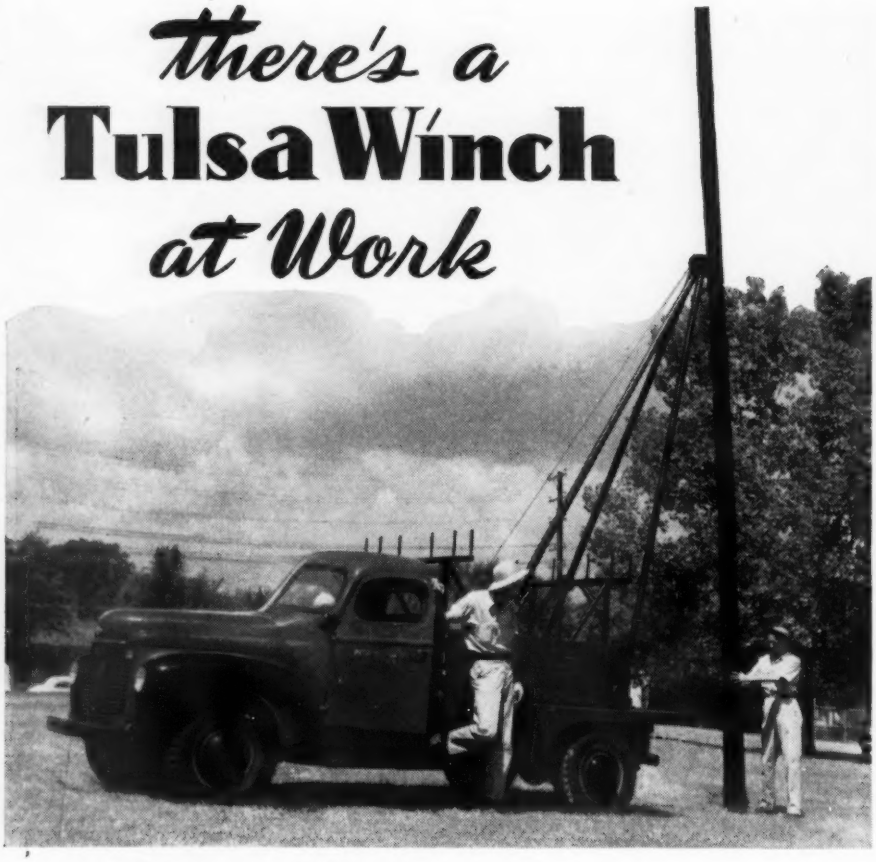
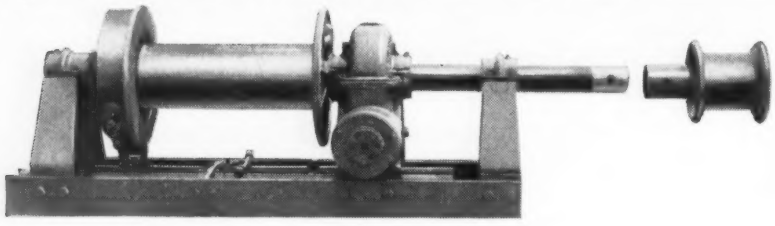
THE GENERAL DETROIT CORP., CANADA, LTD.

TORONTO • MONTREAL

there's a Tulsa Winch at Work





Tulsa Winch with Extended Drum Shaft
for Public Utility Companies
(Note Detachable Cathead and Adapter)

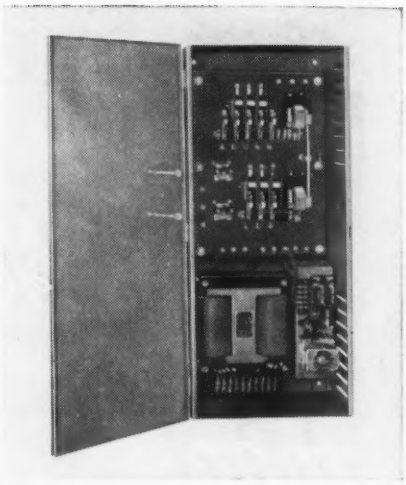
"We Wouldn't Think of Sending Out A Crew Without a Winch Truck . . ."

Such was the comment of one public utility engineer . . . and the winches on the majority of those trucks are TULSA WINCHES. The Tulsa Winch is made in standard, as well as the special utility winch illustrated. The Tulsa Winch has proved invaluable for all the lifting, pulling and reeling jobs in electrical work. This winch is built to your requirements.

A complete line of winches for all trucks,
½-ton to 8-ton and larger.

Write for Literature and further information. Dept. E 122.

Tulsa Winch
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.



2- or 3-phase, squirrel-cage induction motors driving pumps, fans, m-g sets, compressors and other equipments. They are advantageously used where in-rush starting currents must be reduced or where motor starting torque requires adjustment.

The dripproof enclosed starter is compact and conveniently arranged in three removable sections—the contactor panels, the timer panel and the multi-tap autotransformer, providing complete accessibility to individual components. For ease and simplification of installation, all line, load and control terminals are accessible. Adjustable time limit acceleration, over-load protection, mechanical and interlock protection and adjustable taps on the autotransformer are provided on all starters.

Suitable for 2-wire (low voltage release) or 3-wire (low voltage protection) control, the starters are available in standard sizes for use with motor sizes up to and including 100 hp, 550 volts, 60 cycles.

•

Cathode-Ray Oscilloscope

A NEW 7-in. cathode-ray oscilloscope embodies improved circuit features suitable for a wide range of applications in

See how over two hundred unbelievably strong, glass filaments, finer than human hair, are formed into Fiberglas Yarn . . . how the yarns or woven textiles are used as a base for insulating impregnants.

There is a type of Fiberglas Electrical Insulating Material to meet every insulation need. It is available in the form of tapes, cloths, sleeving and tubing, wire and cable insulation, cords, mica combinations and laminates.

Leading manufacturers of motors, transformers and electrical equipment of all types are using these better insulating materials because Fiberglas cannot burn, is unaffected by moisture, is acid resistant, has greater tensile strength and is an excellent heat conductor.

NEW MOVIE "Watts in Glass"

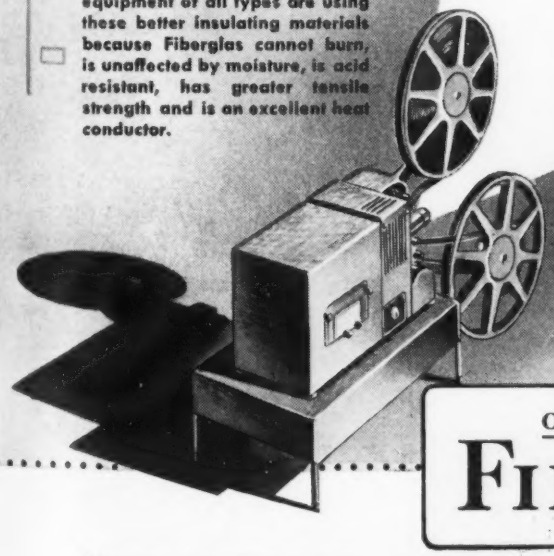
SHOWS WHY more and more industry leaders are insisting on Fiberglas* Electrical Insulation

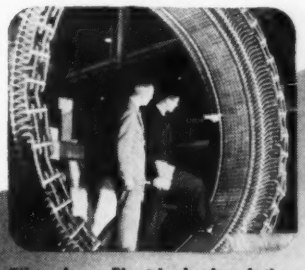
Be sure to see it. It shows designers, engineers and maintenance men how Fiberglas Electrical Insulation can help solve their problems . . . shows how Fiberglas Insulation is being used to do things no other material can do.

HOW TO SEE THE NEW COLOR-SOUND MOVIE "WATTS IN GLASS"

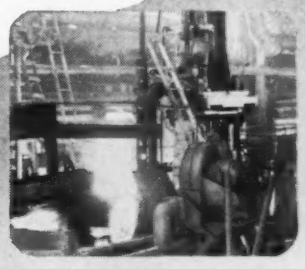
Bookings are arranged through Owens-Corning Fiberglas Corporation Branch Offices in principal cities from coast to coast. Get in touch with the branch located nearest to you—or write Owens-Corning Fiberglas Corporation, Dept. 858, Toledo 1, Ohio.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario





Fiberglas Electrical Insulating Material is used on equipment of all sizes from fractional hp motors for appliances, to the huge generators that supply light and power to entire communities.



Fiberglas Insulation gives electrical equipment extra stamina for all types of "tough" jobs; for example, one large forging mill reported over 365% savings on motors rewound with Fiberglas.

OWENS-CORNING

FIBERGLAS

Reg. U.S. Pat. Off.

ELECTRICAL INSULATION

*Fiberglas is the trade mark (Reg. U. S. Pat. Off.) for a variety of products made of or with glass fibers by Owens-Corning Fiberglas Corporation.

POWER AND DISTRIBUTION

DAVIS TRANSFORMERS

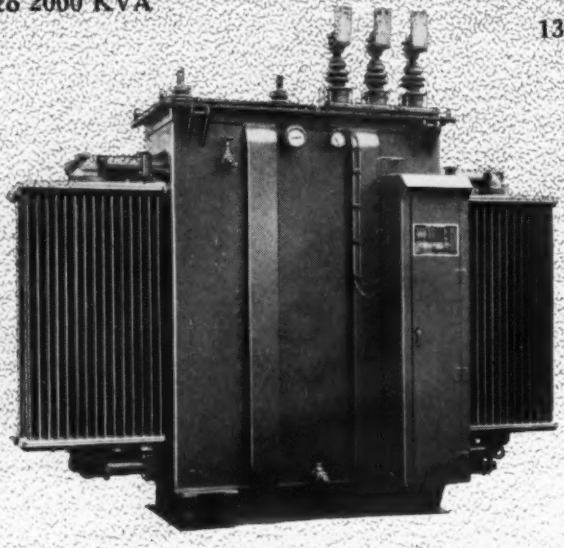
Now forced air cooling gives

INCREASED CAPACITY

without greater size

1500 KVA UNIT Delivers up to 2000 KVA

10,000 KVA UNIT Delivers up to 13,333 KVA



THIS DAVIS POWER TRANSFORMER

1500 KVA — Disc 60 cycle 3 phase
6900/13,800 — 230/460 4 2½% taps

WITH SUPPLEMENTAL FORCED AIR COOLING CARRIES 33⅓% OVERLOAD EASILY and SAFELY

Available in sizes up to 10,000 KVA

RADIATORS CAN BE LOCATED TO SUIT USERS CONVENIENCE

For every Utility or Industry, regardless of the size of the job, you can depend on DAVIS TRANSFORMERS for long life and dependable service under all conditions.

DAVIS TRANSFORMER CO.

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MANUFACTURERS OF OIL COOLED, DRY TYPE, POWER AND DISTRIBUTION TRANSFORMERS

NEMA

radio and electronic circuit alignment, industrial production, and instruction in schools and colleges. The development has been announced by the Radio Tube Division of Sylvania Electric Products Inc, 500 Fifth Ave, New York 18, N. Y.

Patterns traced on a 7-in. cathode ray tube are particularly well suited for instruction in the class room, shop or laboratory. Improved type of push-pull amplifier, using four 7C7 tubes, is said to provide clearer patterns, less distortion and considerably more gain than conventional single stage amplifiers used in general purpose instruments.

Provision is made for Z-axis input with impedance to ground approximating ½ megohm with 30 $\mu\mu$ shunt capacitance. This feature permits a wide variety of study in industrial applications where it is frequently desirable to study portions of wave forms by means of intensity modulation.

The new 7-in. type 132 oscilloscope weighs 37 lb and is 17 in. high, 11⅜ in. long and 17¾ in. deep. It is rated at 35 w, 105-125 v, 50-60 cycles.

•

Silver Solder

AVAILABILITY of a solder with 20 percent silver and having the advantages of high capillary action, high tensile strength and good appearance after brazing has been announced by All-State Welding Alloys Co, Inc, 96 West Post Road, White Plains, N. Y.

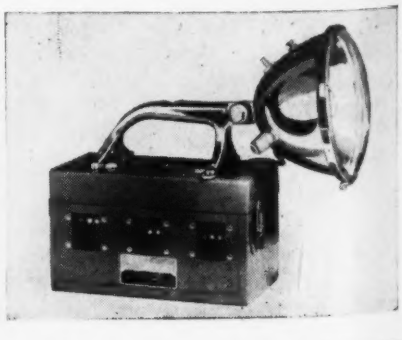
This alloy is stated to have a melting point of 1,430 F and a shear strength of 145,000 psi. It is known as All-State No. 120 High-Strength silver solder, is used with All-State No. 103 flux, and is available in wire, strip or rings.

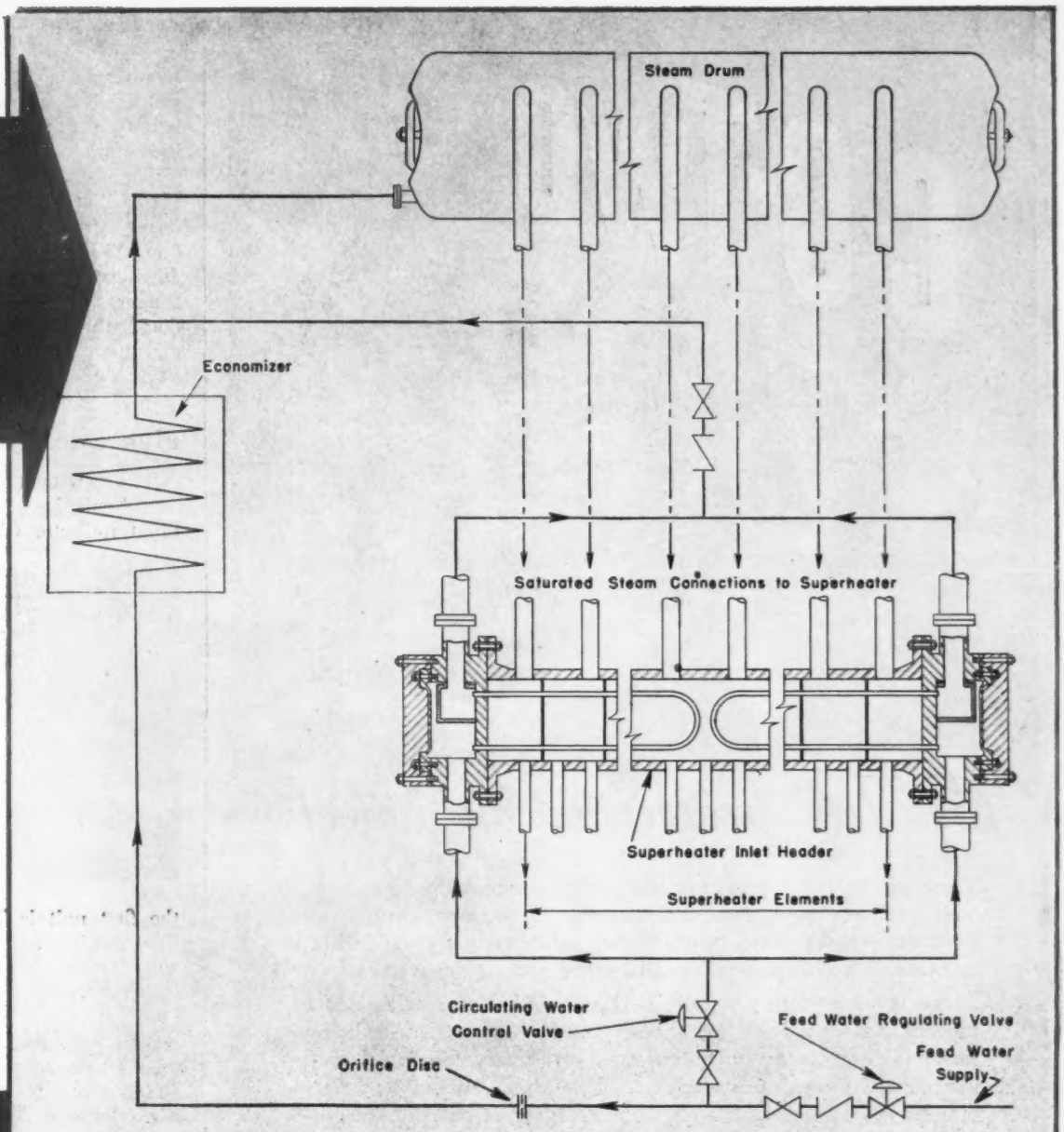
It is said to be particularly suitable for the brazing of carbide tips to steel shanks and for the fabrication of light steel parts. It is also recommended for use on steel, brass, copper, Inconel and stainless steel.

•

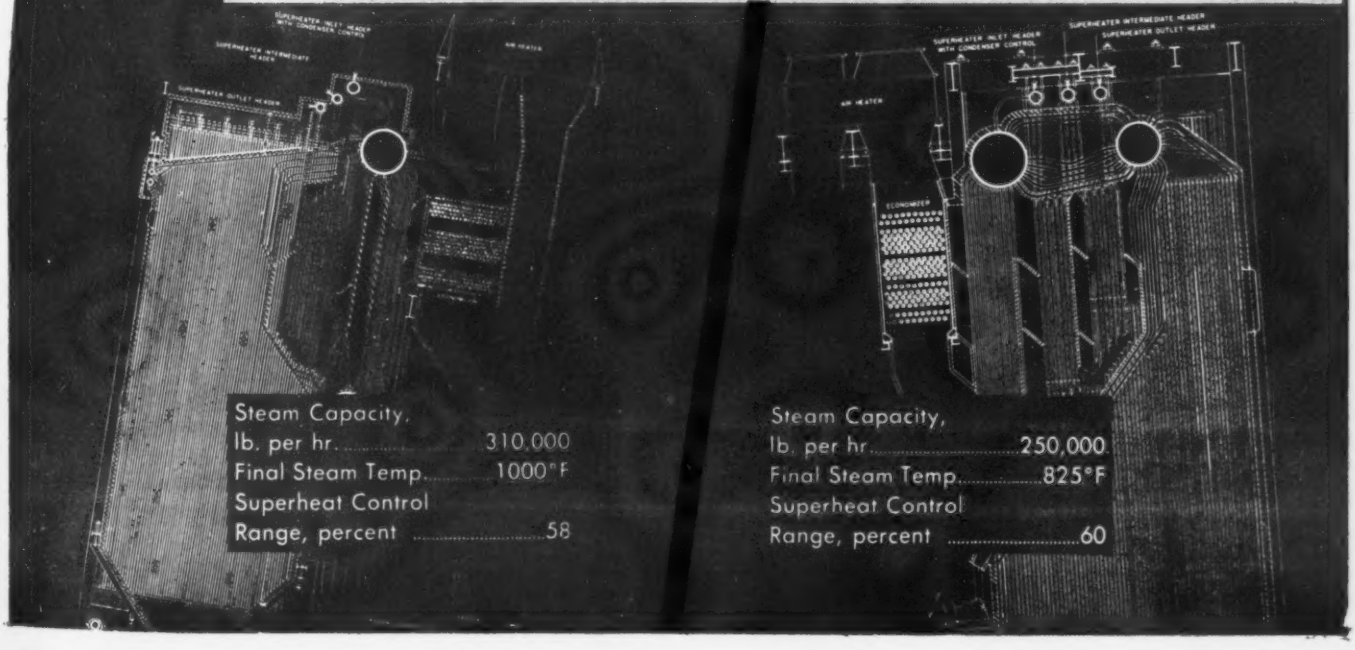
Rechargeable Hand Lamp

DEVELOPMENT of Model 311 portable electric hand lamp which is stated to throw a 2,500-ft beam and is powered





This enlarged section through the superheater inlet header shows the arrangement of condenser-type control of final steam temperature.



Steam Capacity, lb. per hr.	310,000
Final Steam Temp.	1000°F
Superheat Control Range, percent	58

Steam Capacity, lb. per hr.	250,000
Final Steam Temp.	825°F
Superheat Control Range, percent	60

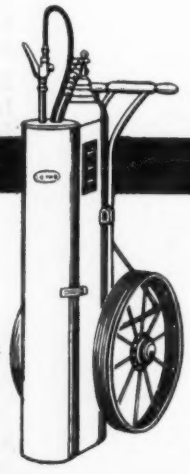
fast fire protection on wheels!

There are probably areas in your plant, remote from each other, which require more than ordinary fire protection: baking and drying ovens, dip tanks, pump houses, solvent baths, spray rooms, transformers, circuit breakers and other electric apparatus.

Large volume, highly mobile C-O-Two Wheeled Portables are especially designed for big, widely scattered hazards. They bring powerful fire protection on the spot in a hurry. Equipped with our famous Squeez-Grip release, C-O-Two Wheeled Portables blanket fire with clouds of dry, non-damaging carbon dioxide gas-and-snow, expanded 450 times its liquid volume. Seconds later the fire's out, and C-O-Two disappears without a trace.

C-O-Two is a modern fire fighter. It's fast, safe, non-conducting, non-corrosive, harmless to equipment and materials.

Our expert engineers will help you plan complete C-O-Two fire protection for your property. Write us today for your free catalog.



The C-O-Two Wheeled Portable is again available equipped with or without metal protective covers for horn and hose, and with steel wheels or rubber tires.

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1, N. J.

Sales and Service in the Principal Cities of U. S. and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY

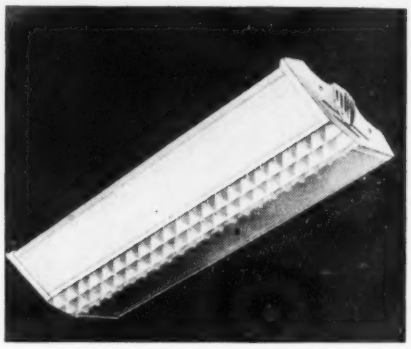
by a rechargeable storage b
been introduced by U-C L
facturing Co, 1050 West Hubbard St, Chicago 22, Ill. The 6-v, 20-amp-hr battery has built-in specific gravity ball indicators.

The 6-in. lamphead has a triple-plated 6-in. diam reflector. Lens is a heavy convex type. Main bulb is rated 6-v, 2.35 amp and has a prefocused base. Auxiliary bulb is a GE No. 55, 6 v. Finger tip control is provided by a double-throw switch of single-pole toggle type.

•

Fluorescent Luminaire

IN A NEW LINE of commercial fluorescent luminaires introduced by Bright Light Reflector Co, Bridgeport, Conn.,



the first unit is The Vanguard. This Silva-A-King addition is a four-lamp, 40-w fixture with glass side panels and egg-crate type louver on the bottom surface.

A hinging mechanism allows the side panels to open and plumb themselves, giving access for cleaning and relamping. Slotted end-sections are fitted with glass panels to permit a soft glow of light, thereby eliminating dark ends.

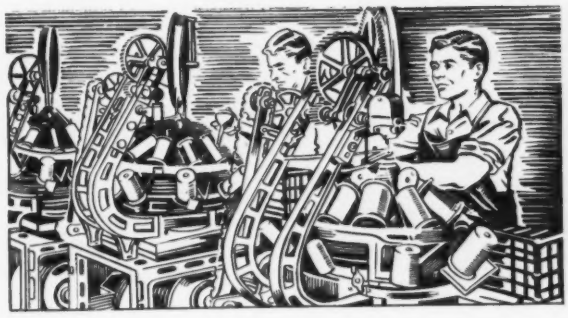
The Vanguard is designed for either suspension or surface mounting, either in single units or continuous rows. It is available with canopy and stems, without louver but with full width glass side panels, and for 110-v and 220-v circuits.

•

Oscillograph Camera

FOR a convenient means of recording oscillograms, Allen B. Du Mont Laboratories, Inc, Clifton, N. J., announces its Type 271-A oscillograph camera. It consists of a camera and a light hood, both of metal construction. This simplified equipment does not require that recordings be taken in a darkened room. The camera clamps on the usual supporting ring of the cathode-ray tube of any standard 5-in. oscillograph, and is automatically positioned for correct and fixed focus. The adjustable mounting permits the camera to be horizontal,

. . . . how much is it worth?



IN 1880, when electric lights first were tried on New York's Broadway, Roebling's confidence in the future of electricity motivated a new Roebling undertaking . . . the manufacture of electrical wire and cable.

Roebling's contribution to this great industry during the past sixty-seven years is a matter of record. Its leadership was attained and is being maintained by rigid high standards of quality . . . tireless development of superior products, better processes, and more efficient methods.

Your confidence in Roebling is valued by every Roebling employee. His income depends upon his ability to preserve that confidence. Every Roebling employee knows that you will continue to prefer the output of his hands only if he produces better products and gives you better service.

Your Confidence in Roebling is Roebling's best salesman.

This applies, not only to electrical wire and cable, but to all Roebling products.

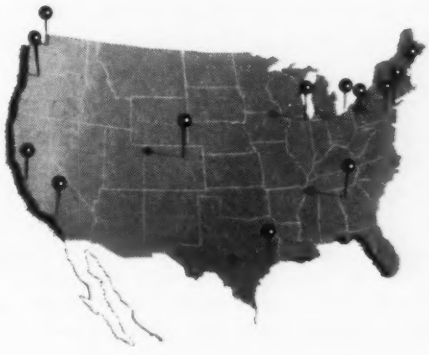
HOW TO SOLVE WIRE AND CABLE PROBLEMS!

ELECTRIC WIRE AND CABLE play an important part in every industry. Their efficient use depends upon their proper application. Hundreds of men in your industry have found a cooperative and helpful friend to lend a hand when they were puzzled with wire and cable problems. He is their Roebling Field Man.

They find that he really knows his electrical products and their applications, yet never hesitates to call on the Roebling Engineers and the Roebling Development and Testing Laboratory.

We, here in Trenton, are constantly being reminded by grateful customers of the ability and integrity of their Roebling Field Man . . . of his honest and successful efforts to prove that the words "Confidence" and "Roebling" are one and the same.

At the right is a listing through which your nearest Roebling Field Man can be contacted. Why not call or write him today? Make an appointment to meet a friend who can save you both time and money.



Atlanta	934 Avon Avenue . . . Raymond 2151
Boston	51 Sleeper Street . . . Lib. 4373
Chicago	5525 W. Roosevelt Rd. . . . Crawford 6400
Cleveland	701 St. Clair Ave., N.E. . . . L.D. 249 & Main 5030
Denver	1635 Seventeenth St. . . . East 2684 & Keystone 4111
Houston	6216 Navigation Blvd. . . . Woodcrest 6-8316
Los Angeles	216 S. Alameda St. . . . Trinity 1261
New York	19 Rector Street . . . Wh. 3-5200
Philadelphia	12 S. 12th Street . . . Market 7-2751
Pittsburgh	855 W. North Avenue . . . Fairfax 2766
Portland, Ore.	1032 N. W. 14th Avenue . . . Broadway 5456
San Francisco	1740 17th Street . . . Market 8787
Seattle	900 First Avenue South . . . Main 4992

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

Electrical Wire and Cable • Suspension Bridges and Cables
Aircord, Aircord Terminals and Air Controls • Lawn Mowers

ROEBLING

A CENTURY OF CONFIDENCE

For more than 45 years the famous STEPHENS Climbers have been exclusively manufactured by

Buckingham

of Binghamton

and in that time one objective has been constantly kept in mind—to maintain the same high quality standards established by Wilmot Stephens when he first forged climbers on a blacksmith's anvil almost a half century ago.

Extreme care is taken to provide safe, comfortable equipment, and every article is inspected to comply with the exacting requirements established by safety engineers.

Buckingham "Cushion Deluxe" Floating Tool Belt No. 58 is made from the best latigo and chrome leathers. It has the "rolled edge" feature that gives a cushion effect with the greatest comfort to the wearer. Rigidly tested for strength and safety.

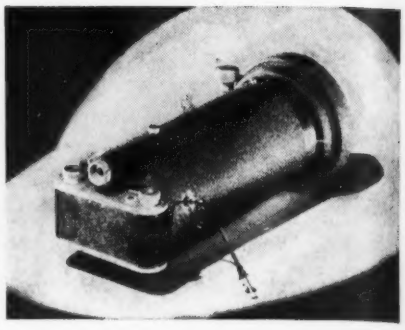
Here's Why Buckingham Climbers are Safer — More Comfortable!

- Shank a perfect fit, shaped for comfort.
- Wide standing surface slightly rounded to fit foot.
- Round loop will not cut straps.
- Gaff is hammer-forged from special tool steel, set straight with body of climber and close to foot-piece, giving least strain to climber, and maximum comfort to lineman.
- Each climber tested for toughness and strength of gaff rivet.
- Each climber Parkerized (rust proofed) and lacquered.

BUCKINGHAM MANUFACTURING CO., INC.

Walter E. Craw, President — 5-7 Travis Street, Binghamton, N. Y.

See your distributor NOW. More than 400 outlets handling Buckingham equipment



vertical or tilted for corresponding images.

Type 271-A is a compact 35-mm camera with fixed-focus f/3.5 coated lens and simpilfied shutter with time, bulb and 1/30 sec. The cathode-ray screen image is observed through the peep-hole at the camera end of the light hood, and the exposure made by conventional cable release. The camera, held on the light hood by bayonet lock and spring detent, is instantly removable for shutter and lens settings, and also for the convenient loading and unloading of film spools.

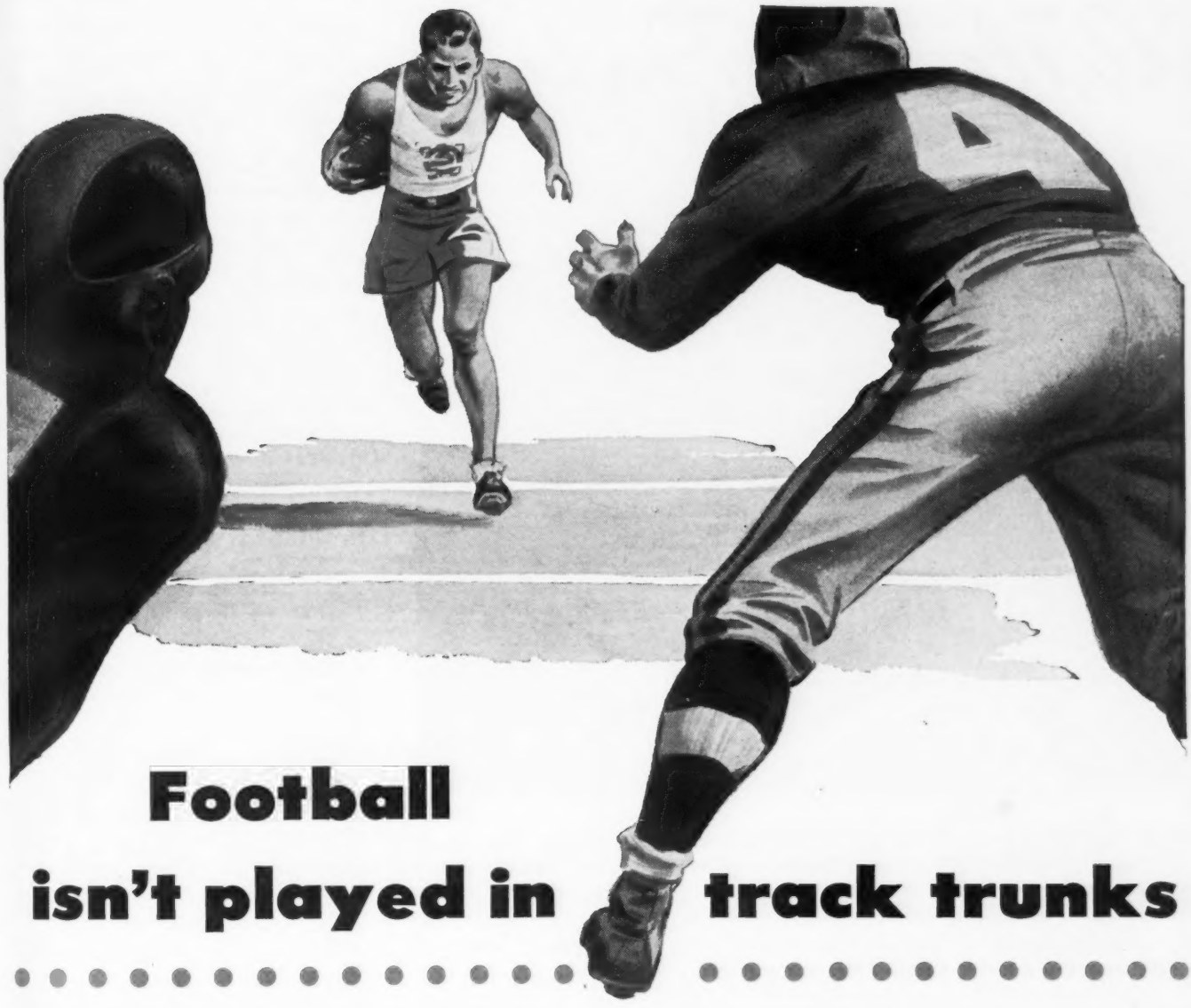
The maximum writing speed of the luminescent spot that can be photographed is dependent on several factors such as lens speed, type of photographic emulsion, tube phosphor, object: image ratio, development technique employed, and spot brightness. However, instructions supplied with the camera help determine proper exposure based on the various factors involved.

•

Earth Borer

DEVELOPMENT of a new hydraulically controlled earth drill, Model HBJ, is announced by the Buda Co, Harvey, Ill. This earth-boring machine drills 6-in. to 42-in. diam holes to depths of 10 ft. It has finger-tip control to permit quick adjustment of drill head to a vertical position, also leveling adjustments for either straight holes or anchor holes.

The drill is designed for pole line



Football isn't played in track trunks

Clad in track suit, what chance would a player have against a team equipped with the "armored" togs of football!

In many phases of production involving paper . . . essential industrial papers, that is . . . it also becomes vital to provide proper physical and chemical characteristics to withstand "unnecessary roughing". Modern MOSINEE papers for the plastics industry, for instance, are engineered specifically for plastics requirements. For the electrical industry and other mechanical applications, MOSINEE paper characteristics are provided for maximum arc resistance, high dielectric strength, low moisture absorption, high strength-weight ratio. For other products and processes, MOSINEE creates special stretching papers, high tensile, high fold and tear resistance, high absorption or moisture repellency papers . . . controlled maximum-minimum pH, and other scientifically created papers . . . dependable in uniformity and performance.

MOSINEE paper technicians are prepared to equip the paper you need with characteristics that improve product and production. Call MOSINEE.

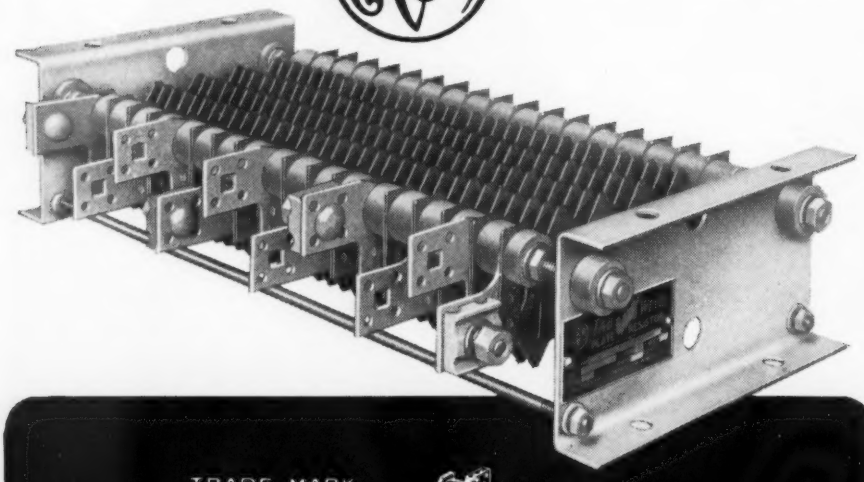
MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

Please address your letter "Attention Dept. B"

A New E&M Product



TRADE MARK

TAB WELD PLATE RESISTORS

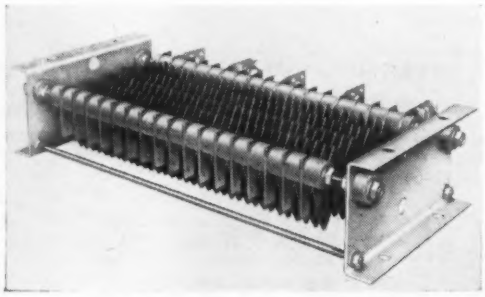
For CONTROLLER and STARTER DUTY

A continuous path from end to end by spot-welding—Terminal-plates for external connections also welded in place.

THESE are non-breakable Resistors having Tab-Weld construction. The grids are stamped from flat-rolled, corrosion-resistant, chromium alloy steel. Off-setting the end-convolutions brings the grid-eyes of adjacent resistors into intimate contact on one side of the section and separates them on the opposite side. High dielectric spacers, used between the separated ends, retain their shape under pressure and will not soften at maximum temperatures.

Tabs at the end of each resistor extend below the grid-eyes and supporting rods. Terminal-plates, placed on the rod at frequent intervals against the mated resistor-ends on one side of the section also have tabs to match with the resistor-tabs. All adjoining tabs are spot-welded together.

Terminal clamp-blocks, having grooves to accommodate several sizes of wire, are bolted to the terminal-plates and are readily movable from plate to plate to provide the desired resistance per step. If flat-bus is preferred for external connections, it may be bolted on by the four holes supplied in each terminal-plate.



New Bulletin 942 completely describes these TAB-WELD Plate Resistors. A copy will be sent promptly on request.

OUTSTANDING ADVANTAGES

NO burning at grid-eyes ● NO burning at taps ● NO periodic tightening of clamping-nuts ● Accurately moulded insulating spacers will not soften below 2000° F. ● Negligible resistance-change between cold and maximum working temperatures ● Grid-stack clamped independently of end-frame clamping. Accurate mounting dimensions maintained regardless of grid-stack length ● All sections of the same width, length and height. The same size resistors used throughout standard mill sections.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79th STREET • CLEVELAND 4, OHIO

construction, pre-boring for piles, foundation hole work, and for other jobs which require the constant moving of equipment. It is powered by a slow-speed, 4-cylinder Buda gasoline engine. The engine, together with the drilling mechanism, is mounted on an I-beam of structural steel. This results in one complete and packaged unit.

A flat-bed truck or a heavy 4-wheel trailer is recommended for mounting the HBJ drill. The unit is quickly removed from vehicle to permit truck or trailer use for other purposes.

A pole setter tower extension and power-driven winch, furnished as optional construction, is a factory installed part of the unit for power pole work.

•

Beading Machine

KNOWN as the Thermobeader, a new machine providing an automatic continuous method for beading straight

edges of thermoplastic sheeting of 0.005 to 0.020 in. thickness has been designed and developed by the Sheet Plastics Equipment Division of Tabor Instrument Corp, North Tonawanda, New York.

Straight-edge beading of cellulose acetate, ethyl cellulose, vinyl acetate and cellulose nitrate sheet, rolls, die-cut blanks and strips is performed at the rate of from 500 to 1,000 in. per min with this new unit, depending upon type and gage of material being processed, the manufacturer asserts. Bead sizes range from $\frac{1}{16}$ in. round to $\frac{1}{8}$ in. square.

The first two dies have cartridge heaters (150 and 350 watts) and automatic temperature control. Machine speed is adjustable by means of a variable transmission. The machine is equipped with all essential controls for operating on 115-v or 230-v 50/60-cycle, single-phase current supply.

NEWS ABOUT PEOPLE

Consumers Power Forms Electric Construction Dept.

Formation of a new electric construction department under the supervision of Carl E. Arvidson has been announced by the Consumers Power Co, Jackson,

C. E. ARVIDSON

Mich. Some changes in personnel have followed the organization of the new unit. Arthur R. Hamilton, formerly general construction superintendent, plants and substations with the production and transmission department, has become general construction superintendent,

A. R. HAMILTON

generating plants. In the new construction department set-up, Edgar A. Cannon, who was field electric construction superintendent, becomes general construction superintendent, transmission

E. A. CANNON

lines and substations.

Mr. Arvidson, who has just been named general supervisor of electric construction, spent four years, 1924-28 with Commonwealth Power Corp and Stevens & Wood on substation design and construction and as investigations engineer. He then became identified with Consumers Power Co, where he served as power sales engineer for nine years. Before entering the U. S. Navy in 1942 he was connected with the Commonwealth & Southern Corp at Jackson, Mich., as distribution engineer. Following discharge from the Navy he was made supervisor of investigations section of general engineering department, Consumers Power Co, the position he occupied until his recent promotion.

Mr. Hamilton first went to Consumers in 1924 on construction work. He left in 1932 and returned in 1936. Since that time he has worked on construction of plants and substations and in 1946 was named general construction superintendent to succeed George F. Stecker. who retired at that time.

Mr. Cannon joined the company in 1928 in the production and transmission construction department at Zilwaukee, Mich. Except for short periods during 1931 and 1932 and during military service in World War II, he has been working ever since on construction jobs in various parts of the Consumers system.

•

► H. G. BLACK has been elected president of the Central Virginia Electric Cooperative, Lovingston, Va.

O'Neill Elected President of Niagara Falls Utility

A. T. O'Neill, president of the Buffalo Niagara Electric Corp, has been elected president of the Niagara Falls Power Co, a subsidiary of Buffalo Niagara Electric. In this capacity he succeeds the late Paul A. Schoellkopf.

Mr. O'Neill became identified with the electric utility business in Central New York 38 years ago and has been associ-

A. T. O'NEILL

ated with the industry in western New York for the past 29 years.

Details of Mr. O'Neill's career were published in the November 17, 1945, issue of ELECTRICAL WORLD at the time he was elected to the presidency of the Buffalo Niagara Electric Corp.

•

► PROF ARTHUR B. BRONWELL, Northwestern University, Evanston, Ill., has been appointed secretary of the American Society for Engineering Education. The headquarters of the society will be moved from the University of Pittsburg to Northwestern University.

•

► HAROLD O. HILL, assistant chief engineer, fabricated steel construction, Bethlehem Steel Co., Bethlehem, Pa., has been elected president of the American Welding Society for the year 1947-48. Mr Hill has held many offices in the society and has been on numerous important committees during the 16

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On emergency jobs . . . on tough jobs . . . on routine jobs . . . the men who string and maintain the nation's power and communication lines rely on Kleins. Wherever you see linemen you'll see Kleins—pliers and wrenches, tool belts and safety straps, climbers and grips.

There's a sound reason for this preference. For linemen and electricians—men who know good tools—also know of the quality materials and expert craftsmanship that go into every piece of Klein equipment. To them this excellence means safety, efficiency, speed . . . on every job.

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Klein-Line Tool Belts

Klein-Kord Safety Straps

Klein Climbers

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The Klein Pocket Tool Guide showing the Klein line and containing useful information will be sent on request.

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years he has been a member of the society. He is also a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Society for Testing Materials, and of other engineering associations.

•

C. H. LeVee Made Manager of Electric Utility Sales

Appointment of Clarence H. LeVee as manager of electrical utility sales has been announced by the wire and cable department of the United States Rubber Co.

Mr LeVee will be responsible for the

C. H. LeVee

sale of electrical wire and cable to electric light and power companies, with headquarters in the company's general offices in New York.

A graduate of Rensselaer Polytechnic Institute, Mr LeVee has held important positions with Depew & Lancaster Light & Power Co, Lancaster, N. Y.; Central Hudson Gas & Electric Corp, Poughkeepsie; Ford, Bacon & Davis, New York, and Fagan Electric Co, Little Rock, Ark.

In the early days of World War II he was superintendent of electrical construction for the Arkansas ordnance plant. Later he supervised electrical construction at other important military installations. In 1943 he enlisted in the Navy Seabees and spent 19 months overseas with the rank of lieutenant commander.

Mr LeVee is a member of the American Institute of Electrical Engineers.

•

► Emory C. Branch, formerly director of the commercial and industrial department of the Puget Sound Power & Light Co, Seattle, has been appointed city manager of Reno, Nev. A graduate in electrical engineering of the Univer-

(Advertisement)

Electrical Industry Solves Auxiliary Housing Problems with Butler Built Steel Buildings

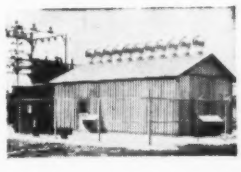
The use of low cost factory-fabricated and packaged steel buildings made by Butler Manufacturing Company for auxiliary housing has eliminated the auxiliary housing bottleneck in the electrical industry. These adaptable, speedily erected steel buildings are effectively serving today as electrical power substations, warehouses, materials depots, machine shops, etc.

Two types of Butler Steel Building construction are described below. They are the Butler Boulevard Building which has a patented key-lock device that locks the aluminum panels together to form the strongest of structural systems and insures quick erection — and the Structural Steel Building, covered with aluminum sheets.

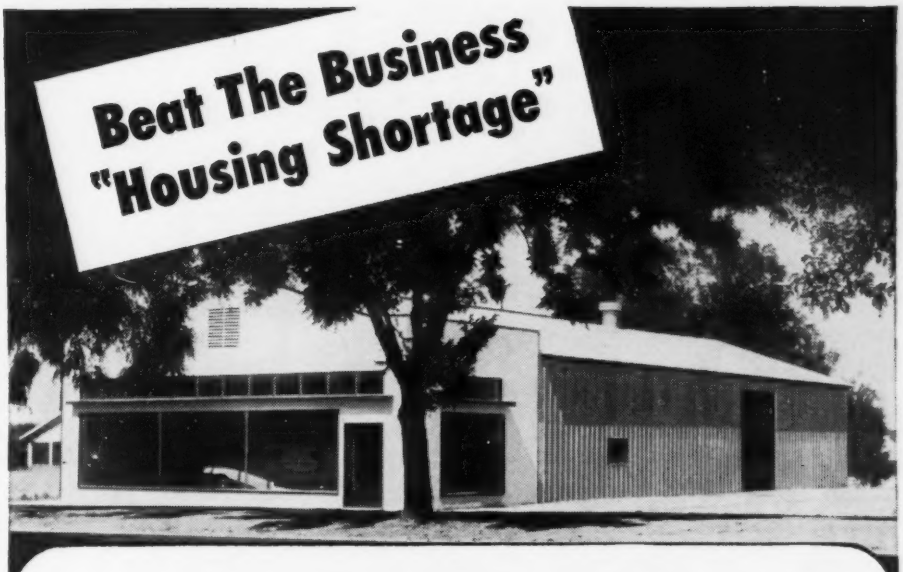
This Butler Boulevard substation comes in these three standard sizes: 18 ft. x 36 ft., 16 ft. x 26 ft., and 16 ft. x 20 ft.; ceilings 9 ft. 10 inches. It features key-lock panel construction with aluminum panels, painted or unpainted. Insulation makes it ideal for use as an unattended substation or a CAX building.

Functional beauty is the keynote of this modern Butler Boulevard aluminum building. As a rural business office or small appliance sales and service shop, its clean open design makes greatest use of natural lighting without sacrificing structural strength. Reversible panel structurals permit use of conventional materials on either interior or exterior to give you an attractive unit at substantial savings. Standard size is 14 ft. x 20 ft.

Synchronous condenser house shown here is one of 29 small industrial type buildings factory-fabricated and packaged in sizes up to 24 feet wide (larger sizes are custom-built). Sturdy bolt-together steel construction. Savings per square foot erected over other similar structures are effected by line production methods. Their strength, adaptability and economy place them high on the list of best sellers throughout the electrical industry.



Butler Steel Buildings are available in more sizes and styles—all at low cost. There's no need to delay longer—see your nearest Butler dealer or distributor for full information, or send coupon.



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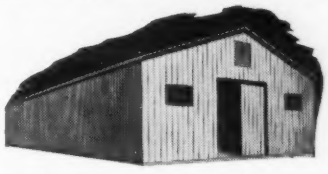
Steel Buildings—Aluminum Covered

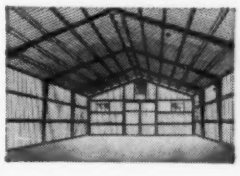
AVAILABLE AT LOW COST!



Butler Steel Buildings are available. Erect them in just a few days and move right in! A practical and surprisingly economical solution to your business housing problem.

What's more, these Butler Steel Buildings give you real savings. The complete building comes to you in one compact shipment, from one source. Savings in freight charges! Butler pre-fabrication makes them easier to put up. Savings in labor and handling charges! Truss-free gables and straight walls give you extra usable space. And the low maintenance cost of Butler Steel Buildings gives you continuous savings all along the line.

These Butler Steel Buildings are available in 40 ft. width, and length in any multiple of 20 ft. Also in 20 ft. and 32 ft. widths with lengths in any multiple of 12 ft. See your nearest Butler dealer or distributor, or mail coupon below for complete information.



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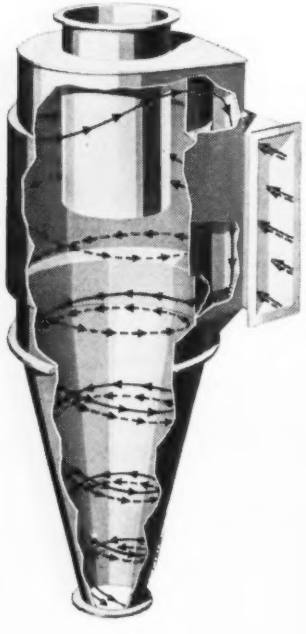


buell

Engineered Efficiency in DUST COLLECTION

sity of Nevada, Mr Branch will be Reno's first city manager. He had been with Puget Sound since 1929, beginning as assistant power sales engineer.

•

Commonwealth & Southern Elects Vice-Presidents

Announcement has been made by The Commonwealth & Southern Corp of New York, the service company for The Commonwealth & Southern Corp system, of the election of W. B. Tippy and H. J. Scholz as vice-presidents.

Mr Tippy has been on the New York staff of Commonwealth & Southern since 1945. At that time he relinquished his duties as assistant to the division manager of the Pontiac (Mich.) division of Consumers Power Co to assist Vice-President J. A. Brown with the operations of Consumers Power Co, Central Illinois Light Co and Southern Indiana Gas & Electric Co. He had been identified with Consumers Power Co since 1936.

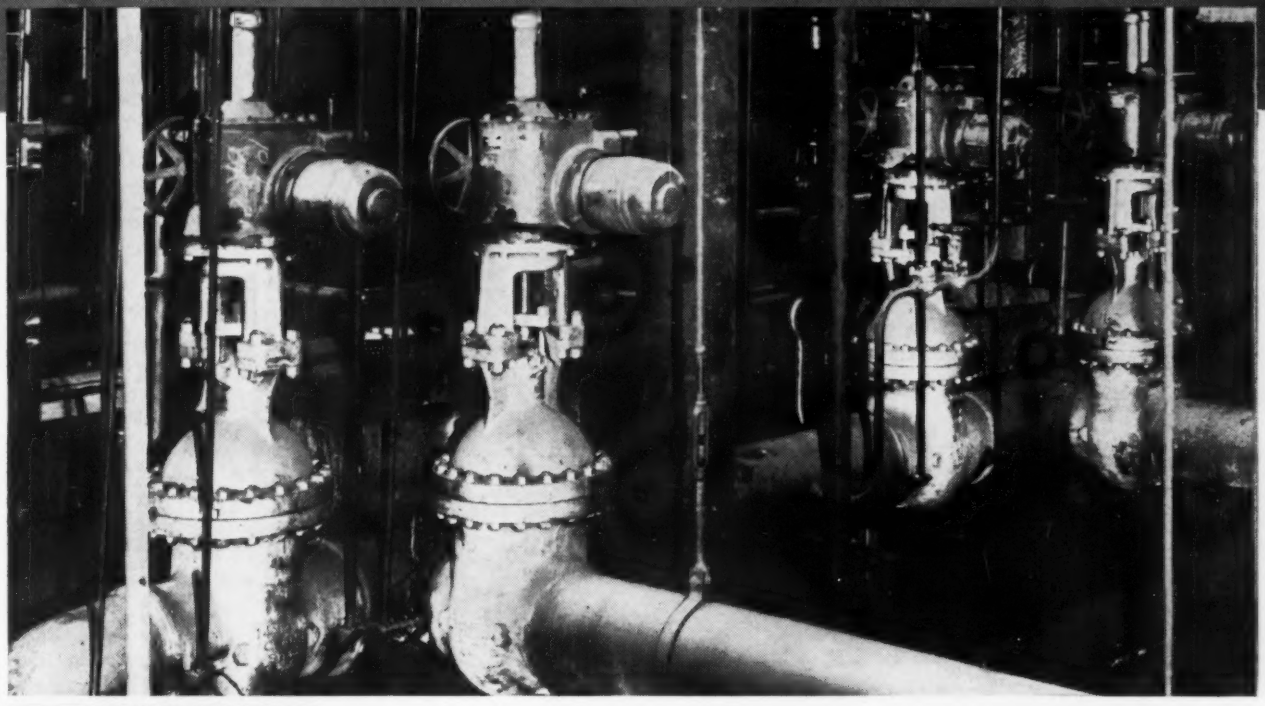
Mr Scholz has been supervising engineer for Commonwealth & Southern Corp Service Co, Birmingham, Ala. He joined the engineering staff of the Alabama Power Co in 1922 and became associated with Commonwealth & Southern in 1931. Mr. Scholz is a fellow of the American Institute of Electrical Engineers.

•

► HAROLD V. BOZELL, president of the General Telephone Corp, New York, has been elected second vice-president of the United States Independent Telephone Association. Mr Bozell was co-editor of ELECTRICAL WORLD from 1922 to 1925. He has been associated with General Telephone since 1932 and has been its president since 1940. Prior to that association he was connected with Bonbright & Co, Inc, investment bankers.

► HAROLD F. WEBB, general safety director of the West Penn System and the American Water Works & Electric Co, Inc, has been elected president of the Veterans of Safety at their annual meeting in connection with the National Safety Congress in Chicago early last month. Mr Webb is a charter member of the Veterans of Safety. He has been engaged in safety engineering work for 32 years, and associated with the American Water Works system for the past 24 years. The Veterans of Safety, organized in Chicago in 1941, has a membership of 650 men who have been consistently and actively engaged in various phases of safety work for

AT "SOUTHWARK STATION," Philadelphia Electric Co. . . . . 91 *Limitorque* Motor Operated Valve Controls are Installed



THE TYPE "S" LIMITORQUE

. . . on Valves Ranging from 3" to 24" Diameter

The 91 Limitorque Motor Operated ("push-button") Valve Controls in this modern central station, were used on boiler feed, circulating water, main steam and secondary steam lines . . . operating under temperatures from cold water to 950° F . . . from 50 p.s.i. to 1400 p.s.i.,—and needless to say, we are very proud that **Limitorque Controls* were chosen by such an important and up-to-date central station.

As the name implies, "Limitorque" actually "limits the torque" applied to the operating parts of the valve upon which it is installed; thereby preventing damage to valve discs, stems or seats.

Push-button control offered by "Limitorque" eliminates the slow, cumbersome and frequently hazardous task required by manual operation of valves, — and too, valves are closed at "just the right speed."

"Limitorques" are widely used on gate, globe or plug valves; are self-contained units and may be mounted on top of valve yoke . . . no extra gears, nuts or bearings are required and all clutches and connecting sleeves are eliminated.

Write for a copy of our new technical and profusely illustrated catalog now being printed . . . we shall be glad to send you a copy as soon as it is off the press. (Please use your business letterhead when writing for same.)

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Philadelphia GEAR WORKS INCORPORATED

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

—here's how to SAFEGUARD it!

Rush carbon dioxide to the scene in a *Kidde* Trailer

No quicker way than a *Kidde* Trailer Unit to get your fire-fighting equipment to the scene of remote blazes—like those in underground cables. And no quicker way than carbon dioxide to *kill* the fire!

Just discharge the carbon dioxide from the Trailer Unit down the manhole nearest the fire. The carbon dioxide swiftly works its way through the cable ducts—to smother the fire wherever it started.

Remember . . . carbon dioxide is dry, inert, non-conducting, clean.

Kidde Trailer Units are built to specification for *your* requirements. A typical unit carries a hose reel with a 300-pound supply of carbon dioxide, 2 *Kidde* 15-pound Carbon Dioxide Portables, and 2 *Kidde* Water Extinguishers.

Ask a Kidde representative for full details.

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15 or more years. They assist the National Safety Council and its sections, and other groups having safety as an activity.

•

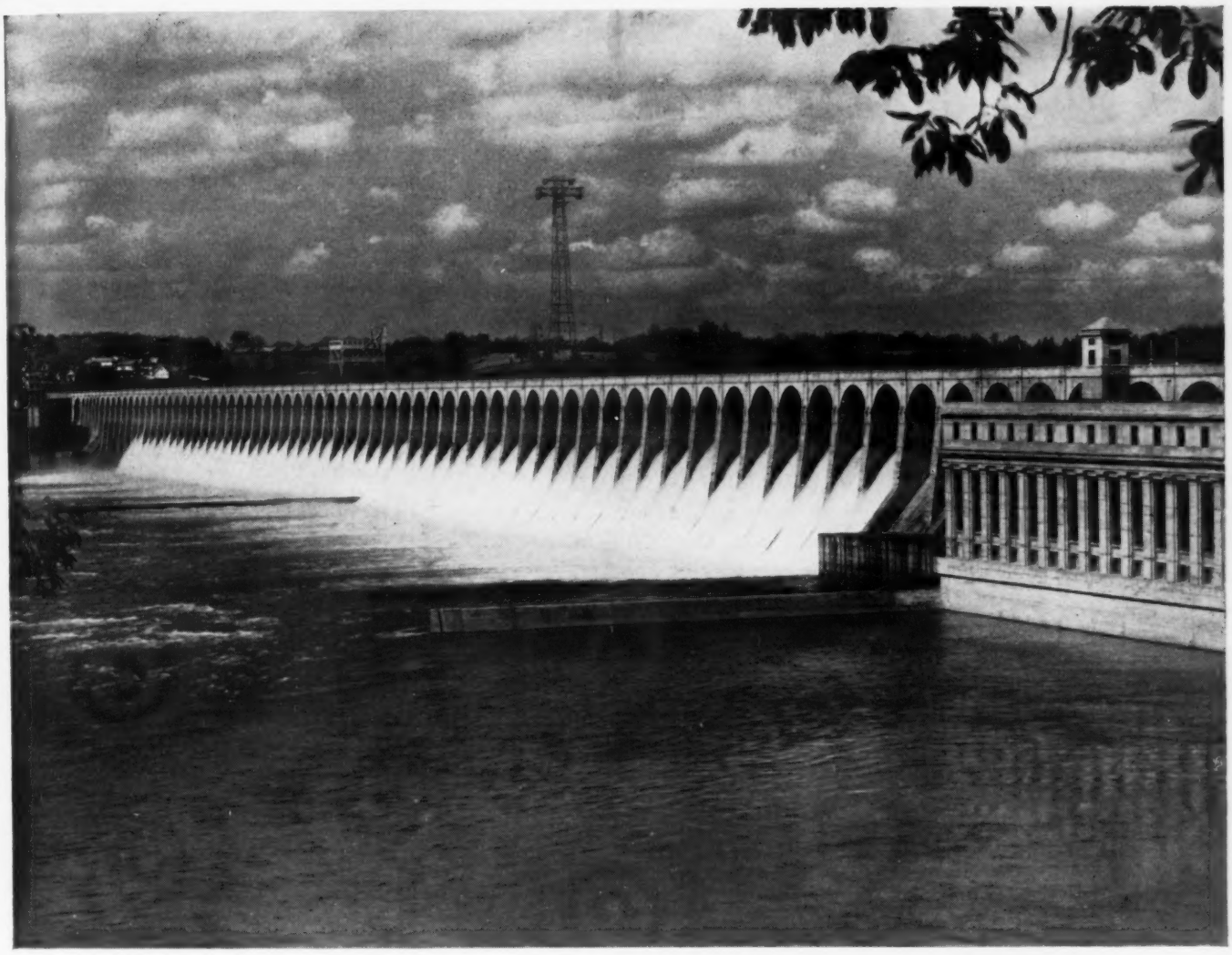
General Electric Announces Engineering Appointments

General Electric Co has recently made new engineering appointments in various departments.

Three staff appointments have been announced by J. W. Belanger, newly named manager of the turbine and gear divisions of the apparatus department. They include: C. S. COGGESHALL, manager of sales; W. E. SAUPE, manager, Schenectady turbine manufacturing division and W. L. Young, manager Lynn turbine and gear manufacturing division. Mr. Coggeshall joined GE in the test course and became associated with turbine sales work in 1915. Mr. Saupe entered the test course in 1917, and has served in the testing division, armature department, motor and generator department, as superintendent of the motor department, in Syracuse and again at Schenectady as superintendent of the turbine manufacturing division. Mr. Young joined General Electric at Ft. Wayne, Ind. in 1913. After serving in various capacities, he was named superintendent of the transformer manufacturing department. Then he was transferred to Pittsfield, Mass., and was named manufacturing engineer of the turbine-gear division at the Lynn River Works in 1942.

FRANK T. LEWIS has been appointed assistant manager of the Schenectady Works. Mr. Lewis joined General Electric in 1916. After holding a variety of positions at West Lynn, he was transferred to the Schenectady Works in 1943 and was named assistant to the works manager to give particular attention to the transmitter manufacturing divisions at Schenectady and Syracuse.

W. V. MERRIHUE has been appointed manager of community and employee relations for the General Electric apparatus department. Mr. Merrihue will be in charge of policy pertaining to community and employee relations for the department. He has relinquished his position as manager of the advertising and sales promotion divisions, apparatus department. Simultaneously, J. S. SMITH was named to Mr. Merrihue's former position. Both men remain at Schenectady, Mr. Merrihue joined the GE publicity department at Schenectady in 1925. Subsequently he served as assistant manager of the industrial advertising section of the department, as division manager of central station advertising, assistant to the



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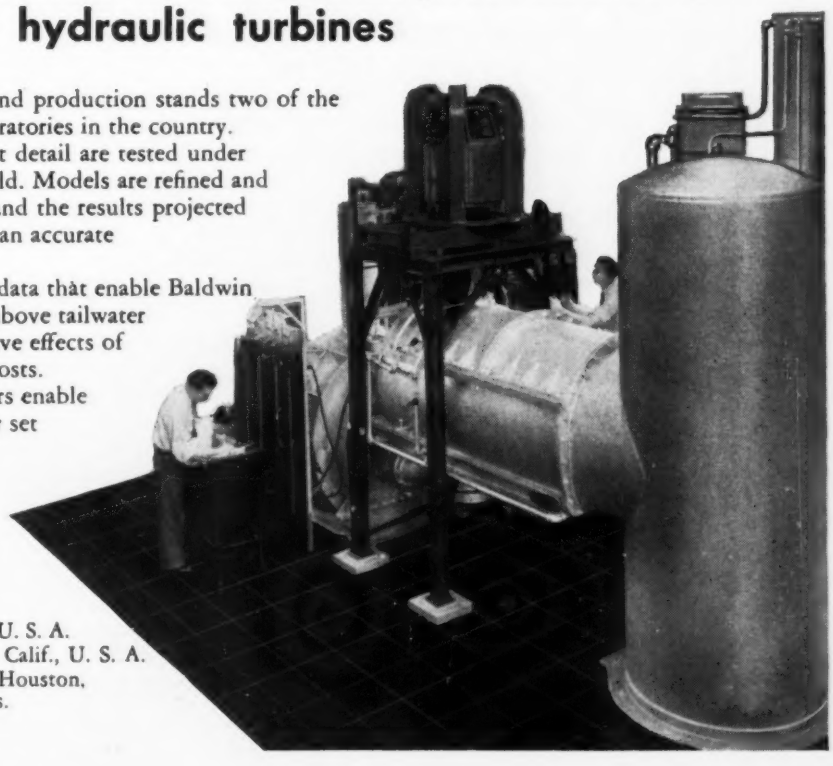
through lower installation costs and higher efficiency for your hydraulic turbines

Behind Baldwin hydraulic turbine design and production stands two of the most modern, completely equipped hydraulic laboratories in the country.

Here, scale models, accurate to the smallest detail are tested under conditions simulating those encountered in the field. Models are refined and checked to attain the greatest possible efficiency and the results projected to the full scale equipment, thus making possible an accurate forecast of turbine performance.

Extensive cavitation studies have provided data that enable Baldwin to offer turbine designs which may be set higher above tailwater and operate at higher speeds without the destructive effects of cavitation, resulting in reduction of powerhouse costs.

Test records compiled over a period of years enable Baldwin to offer a basic turbine design to suit any set of operating conditions, and continuing research insures the latest improvements and highest efficiency in each new turbine installation.



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The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A.
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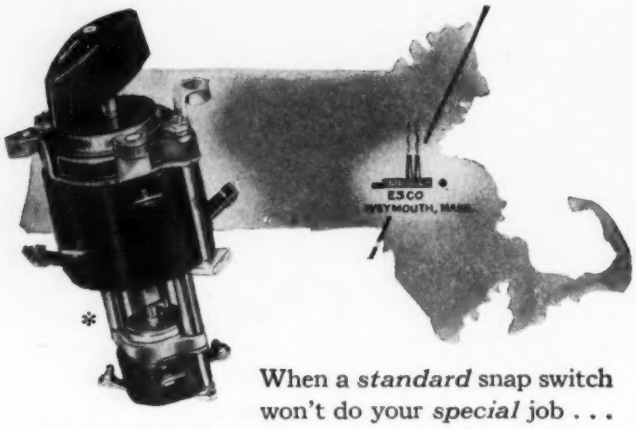

When a *standard* snap switch won't do your *special* job . . . that's when ESCO can help you. Over 90% of our production is special in one way or another.

Special

. . . contact arrangements
. . . operating sequences
. . . load combinations
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SPECIAL LOW COST, too . . . made possible by our use of standard, uniform components, assembled by experts in the construction of snap switches *specially* built for your *special* job.

THESE BASIC FEATURES
can be standard in your special switches.

CURRENT RATINGS . . . 10, 30, 60, 100 and 200 amperes
VOLTAGE RATINGS . . . up to 460 volts a-c
NUMBER OF POLES . . . one to 20
NUMBER OF POSITIONS . . . 4
HANDLE STYLES . . . oval, pistol-grip or removable
MOUNTINGS . . . base or panel
CONNECTIONS . . . side or rear

Don't lose valuable time hunting in catalogs for a *standard* switch for your *special* need . . . just write us your requirements and we'll give you full details on the ESCO switch that meets your specification.

* This ESCO switch, used for oil circuit breaker control, comprises a 2PDT, 30-ampere, 3-position, spring-return unit with a DPST, 10-ampere auxiliary; specify No. 8431A.

ELECTRO SWITCH CORP.
193 BROAD ST. WEYMOUTH 88, MASS.

manager of the publicity department and then as manager of the newly-formed advertising and sales promotion divisions, apparatus department. Mr. Smith has been with General Electric since 1936. He was placed in charge of program preparation for the company's "More Power to America" program in 1944 and subsequently became manager of the visual education division of the advertising and sales promotion divisions, the position he held prior to his latest appointment.

Managers of engineering, manufacturing and sales for the company's meter and instrument divisions have been named by N. M. DuChemin, manager of the divisions. I. F. KINNARD was appointed manager of engineering; H. L. Ross manager of manufacturing and E. H. HOWELL manager of sales. All three men have been affiliated with GE's meter and instrument business in similar capacities. Mr. Kinnard was works engineer of the West Lynn (Mass.) works headquarters of the meter and instrument divisions. Mr. Ross was general superintendent of the works. Mr. Howell was manager of the sales units comprising the former meter and instrument division, which embraced commercial operations exclusively.

VICTOR E. GOODWIN, managing engineer of the lightning arrester, cutout and capacitor divisions at the Pittsfield apparatus works, has retired from the company after 43 years of service. Mr. Goodwin is a past-chairman of the Pittsfield section of the American Institute of Electrical Engineers.

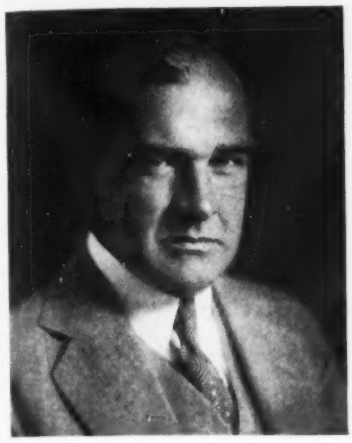
W. S. GINN has been appointed assistant manager sales in the power transformer section, transformer division. Mr. Ginn completed the test course and joined the power transformer commercial section. After military service, 1941-1945, he returned as a sales engineer in the power transformer section where he remained until his recent promotion. He is a member of A.I.E.E.

OBITUARY

► ALBERT KALIN, consulting electrical engineer with offices in Cleveland, Ohio, died in Akron on October 18 of a cerebral hemorrhage suffered while on a business trip in that city. Mr Kalin was born in Portland, Ore., 55 years ago. He was a graduate of the University of Washington at Seattle, where he later taught electrical engineering. In recent years, Mr Kalin had been active particularly in the development of hydraulic speed governors for electric motors.

Bernard F. Weadock

Bernard F. Weadock, formerly vice-president and managing director of the Edison Electric Institute, whose death was announced in Electrical World,



November 1, page 19, entered the utility industry in the role of legal adviser. It was in 1928 that the Joint Committee of National Utility Associations engaged him to act as special counsel in the Federal Trade Commission's investigation of electric and gas utilities being conducted at that time.

So ably did he perform these duties that the National Electric Light Association appointed him managing director in 1932 and when the Edison Electric Institute was organized as successor organization the following year he was made at first executive secretary and then vice-president and managing director, a position he occupied until 1939. He then engaged in the general practice of law in New York and later in Washington, D. C., in the latter city in association with the firm of Palmer, Stellwagen & Neale.

Mr. Weadock was born in Saginaw, Mich., in 1884, and after an extended legal experience in the public utility field he became a member of the law firm of J. C. and B. F. Weadock, general counsel for the Commonwealth & Southern Corp. This connection he severed to represent the utility industry in the FTC investigation.

▶F. Ellwood Smith, 87, at one time manager of the Somerville (Mass.) Electric Light Co, and for 44 years on the staff of the Boston Edison Co following the acquisition of the former utility, died in Somerville October 15.

▶George A. Swanson, 54, an engineer in the valuation department of Jackson & Moreland, Boston consultants, died at Needham, Mass., on October 25. He was born in Boston and was graduated from Tufts College in 1918.

The Philharmonic is down on the farm

Those sounds drifting out into the night aren't what you might expect. You won't hear the groan of a parlor organ, but the deep-throated song of the cello—the full grandeur of a symphonic broadcast.

Rural electrification has not only brought labor-saving tools to the farm, but also many of the pleasures and conveniences of city life.

The electrical farm is here in the United States. Owens-Illinois is proud to have carried an important role by supplying dependable pin-type glass insulators for medium voltage power lines. Traditional Owens-Illinois quality is maintained in every step of manufacturing, testing and inspection.

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Inspection of Owens-Illinois Power Insulator No. 514 (designed for 15,000 volt lines) is conducted in accordance with Edison Electric Institute specifications TD-51-1942, as is the inspection of all Owens-Illinois Power Insulators.

These insulators are manufactured by a pioneer company in the glass insulator field and are sold by principal jobbers.

OWENS-ILLINOIS POWER INSULATORS

Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana

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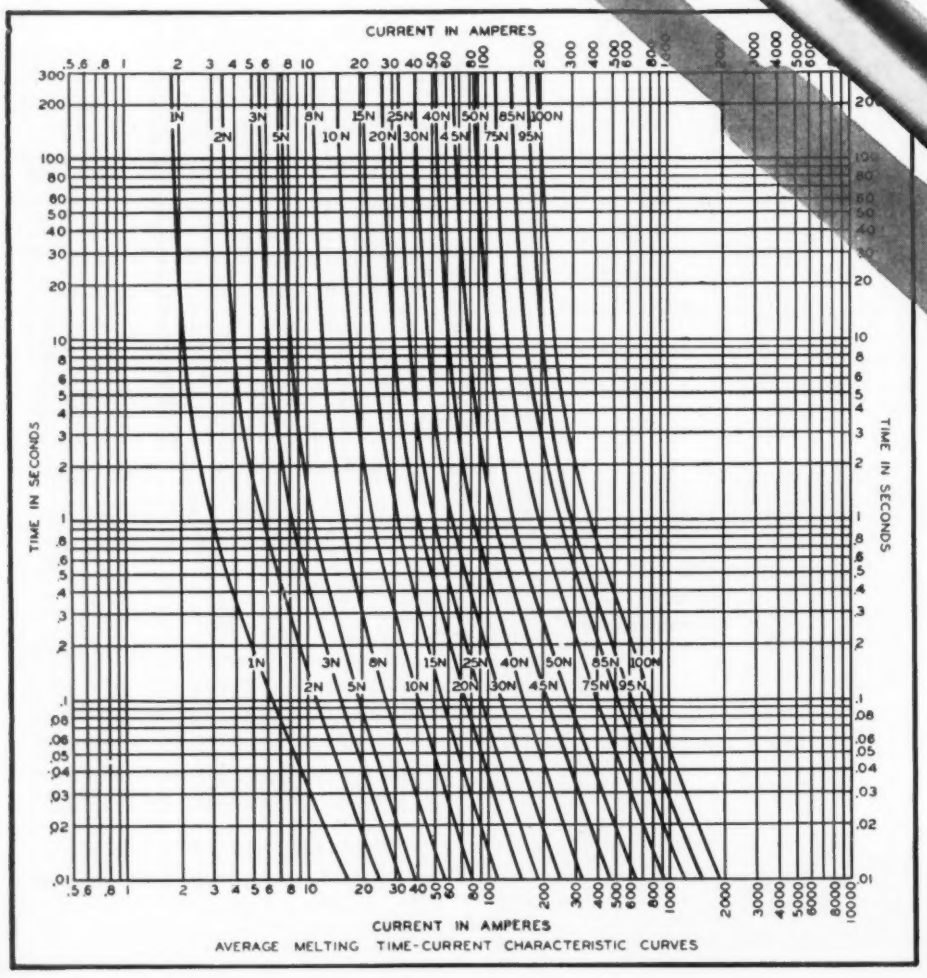
are essential to better fuse performance. These characteristics are designed into the SERIES 50H and 100H UNIVERSAL MATTHEWS FUSE LINKS. Using closely calibrated, high tensile strength materials for the fusible elements and assembling parts by crimping (not soldering) assures uniform accuracy and greater strength and permits closer fuse coordination accuracy. They are available in the standard ratings from 1 to 100 amperes and are manufactured in compliance with NEMA Standards — Publication 38–53.

For further information write for Bulletin 533. Large Time Current Characteristic Curves will also be furnished upon request.



AVERAGE MELTING TIME-CURRENT CHARACTERISTIC CURVES

Each Individual Fuse Link Protected by a Paper Tube and Packed 25 in Telescoping Container

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MANUFACTURERS & MARKETS

Electric Lamps . . . Production, Shipments and Stocks, Second Quarter 1947
(Quantities in thousands and value in dollars)

Product	Production	Shipments				Stocks, End of Second Quarter
		Domestic		Export		
		Quantity	Value (dollars)	Quantity	Value (dollars)	
General lighting, 150 watt and below	176,355	154,425	11,375,530	5,274	422,380	104,370
General lighting, above 150 watt	15,279	14,135	3,339,261	280	78,045	9,055
Photoflash	20,545	18,027	1,476,673	590	48,623	7,805
Photo flood and photo enlarger	1,227	725	169,761	30	9,943	1,780
Infrared heat lamps for therapeutic use	375	184	106,400	8	8,732	1,580
Infrared drying lamps for industrial use	265	197	147,533	12	9,327	399
All other large incandescent (special purpose)	56,736	38,735	6,955,157	4,759	932,357	59,723
Total large incandescent	270,783	226,428	23,570,315	10,954	1,509,407	184,712
Miniature incandescent*	136,725	118,893	8,014,268	7,360	547,789	66,084
Germicidal, sterile and bacteria lamps	30	37	113,336	3	8,223	352
Fluorescent, hot cathode	22,519	19,911	10,197,009	1,139	592,893	9,747
Miscellaneous	5,665	1,038	1,192,099	27	34,016	13,308
Total electrical discharge	28,214	20,986	11,502,444	1,169	635,132	23,408
Christmas tree (all types)	64,913	56,299	1,874,601	561	21,232	44,562
TOTAL	500,635	422,606	44,961,628	20,044	2,713,560	318,706

*Includes auto, medical instruments and miscellaneous.

General Electric Drops Profit-Sharing Program

General Electric Co has announced that it will abolish its profit-sharing plan for non-executive employees. The plan will be retained for executives. Payments will continue on the company's 1947 earnings; so the final payments will be made next March.

In making the announcement, President Charles E. Wilson said, the profit-sharing program for production workers "no longer served its purpose" of promoting employee interest in the welfare of the business. However, he contended, it did serve as an incentive to executives to enhance the prosperity of the company and to create more jobs and more earnings for employees.

When the profit-sharing plan was begun in 1934, participation was limited to employees with at least five years of service. It was intended as an inducement for these employees to remain with the company. Later when the United Electrical, Radio & Machine Workers, CIO, organized the employees all were made eligible to participate.

The union has protested the abolition of the plan and has announced that this will be taken into consideration when new wage demands are presented to the company in spring. The company countered by saying that union representatives were warned in contract negotiations last April that any further increase in wages would be followed by elimination of the profit-sharing plan. The union won a general increase averaging 15½ cents an hour for its members. GE also said that a new pension plan adopted voluntarily will cost the company more.

•

Weston Instrument Opens New Building at Newark

The new 3-story Engineering-Administrative building of Weston Electrical Instrument Corp, Newark, N. J., was opened officially (Oct 24) at which time E. F. Weston, chairman of the board, in greeting the guests stated, "This . . . marks the transition from rather inadequate engineering facilities to those of the most modern. We have chosen to combine the completion of this new building with the commemoration of our sixtieth anniversary." An inspection trip followed.

A total floor area of 78,000 sq ft has been added to company facilities. Designed on a 6-ft module, with movable steel partitioning, laboratories and office quarters may be set up and changed as required. Water, air, gas, and a variety of electrical services, also telephone, signal and special circuits in ducts, are contained in a chase which runs completely around the building on each floor. Under-floor ducts are available on 6-ft centers for services. An 800-amp bus duct runs along the center of the engineering area to supply large blocks of power such as for a furnace or other power consuming units. Lighting is provided by individual fluorescent units and stated to be approximately 50 ft-c at the desk level.

Lamp Shipments Increase 8% in Second Quarter

The 443 million lamps shipped during the second quarter of 1947 represented an increase of 8 percent over the shipments during the first quarter of 1947, according to reports from 30 companies filed with the Bureau of the Census, Department of Commerce. The value of lamp shipments during the second quarter amounted to more than $47 million, an increase of 7 percent over the first quarter. Production of lamps during the second quarter amounted to 501 million, which represented an increase of 10 percent over the production for the first quarter.

In this survey, shipments represent lamps shipped from the factory or factory warehouse and do not represent the sales of lamps to ultimate consumers. The dollar value of shipments is based on the manufacturer's selling price, f.o.b. factory or works, exclusive of all excise taxes and before cash discounts have been taken.

The 30 companies reporting represent virtually all producers of these types of lamps.

•

Forms Own Organization

Wally B. Swank, formerly sales manager of the E. F. Johnson Co, Waseca, Minn., has announced the formation of his own organization in Syracuse, N. Y., 400 Cherry Road, Syracuse 9, where he will represent the manufacturers of several lines of elec-

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¼ to 333 Kva. Single phase. 1 Kva. to 1000 Kva. 3-phase.

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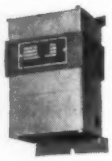

¼ Kva. Single Phase 460/230 to 115 Volt

For interior high voltage distribution systems with transformers at load centers.

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50 Kva. Single phase Floor Mounting Type. With cover of connection compartment removed, showing solderless terminals.

15 Kva. 3-phase Wall Mounting Type. Showing connection compartment with solderless terminals.

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Pioneers in the development and manufacturing of Air-Cooled transformers.

trical and electronic equipment for all of New York State except New York City. Prior to his two-and-a-half year tenure as head of sales for the Johnson organization, he spent eight years as a manufacturers' representative for a number of electrical and electronic lines in the Midwest.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

OHIO BRASS CO, Mansfield, has appointed E. C. Thompson district manager of the Texas territory, with headquarters in Dallas. The Texas territory was formerly handled by the late T. B. Jones.

VICTOR ELECTRIC PRODUCTS, INC, Cincinnati, has appointed Peabody Brothers, manufacturers' sales agents, Unit #2 Santa Fe Building, Dallas, Tex., as southwestern representatives.

ALLIS-CHALMERS MANUFACTURING CO, has appointed G. Edward Conn, Jr, manager of its newly established branch office at York, Pa. MacGregor G. Jones, formerly resident representative at the A-C Harrisburg branch office, which has been discontinued, will assist Mr Conn at York as sales representative.

RILEY STOKER CORP, Worcester, Mass., has appointed E. U. Titus as eastern sales manager with headquarters at their New York office.

T. J. COPE, INC, Philadelphia, has appointed Charles E. Adams as agent covering the western Pennsylvania and West Virginia territories, with offices at 208 Kirby Bldg, Pittsburgh, Pa.

COPPERWELD STEEL CO, Glassport, Pa., has named Walter Pons sales engineer, covering Indiana and the southern peninsula of Michigan, with headquarters at 122 South Michigan Ave, Chicago. Mr Pons was formerly in the company's engineering department at Glassport.

GILLINDER BROTHERS, INC, Port Jervis, N. Y., has appointed R. E. Magnell of 245 South LeCato Ave, Audubon, N. J., and 3219 Mt. Pleasant St, N. W., Washington, D. C., to handle their line of illuminating, industrial and commercial glassware in eastern Pennsylvania, southern New Jersey, Delaware, Maryland and the District of Columbia.

•

G.E. Hires 750 Grads

More than 750 engineers, physicists, and chemists, recent graduates of 150 colleges, have been hired this year by General Electric Co. This is nearly twice the normal number hired. In addition 100 non-engineering graduates have been hired. Company expansion and war-time shortages of college engineering graduates led to the heavy employment figure.

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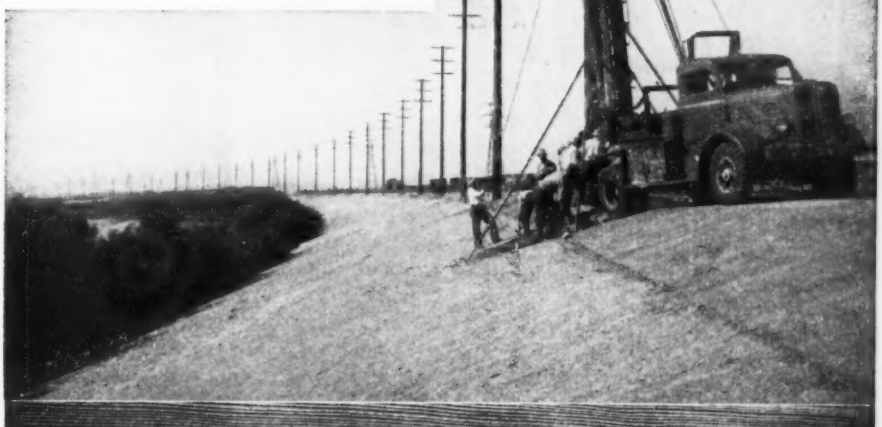

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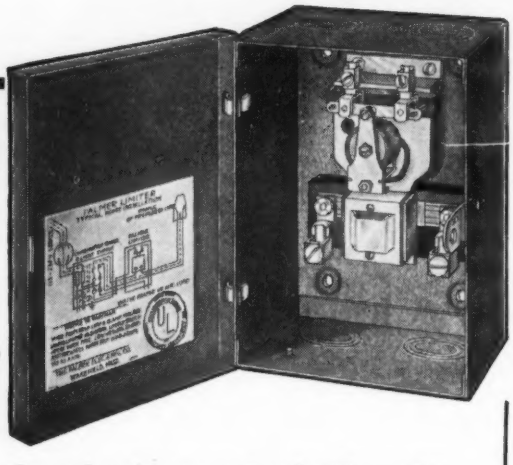

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CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Alabama—Covington Electric Co-operative, Andalusia, sys. imprvs., 528 mi. rural distr. lines, Covington Co. **$1,080,000.**

Arkansas—Ozark Rural Electric Co-operative Corp., Fayetteville, 336 mi. rural distr. lines, Washington Co. **$705,000.**

Calif., Button Willow—Pacific Gas & Electric Co., 245 Market St., San Francisco, soon lets contract steam power plant about 1½ mi. from here.

Illinois — RURAL DISTRIBUTION LINES—M. J. M. Electric Co-operative, Inc., Carlinville, 230 mi. rural distr. lines Sect. N, Macoupin, Jersey, and Montgomery Counties, **$300,000**; sys. rehabilitation, incl. lines, poles, etc., **$195,000.** Rural Line Engineers, 2 S. Central Ave., Clayton, St. Louis 5, Mo., consult. engrs.

Ind., Jasper—Bd. P. Wks., A. J. Sermershein, clk., municipal power plant, imprvs., incl., rein.-con. fdn. for 5,000 kw. generator, steam piping, electric wiring, structural steel, chlorinator, 50 g. p. m. condensate pump. $150,000. Plans deposit $25. Bevington-Taggart & Fowler, 730 Ind. Pythian Bldg., Indianapolis, consult. engrs.

Ia., Bancroft—City, light plant sys. imprvs., incl. plant addn., diesel engine generating unit, power wiring, switchboard changes, extens. $60,000. A. S. Harrington, P. O. Box 452, Omaha, engr.

New Jersey and Pennsylvania—Electric Power Co. of New Jersey, Inc., Trenton, N. J., hydroelectric development in Delaware River, 2,340 ft. dam at Tocks Rocks with 679,000 acre ft. capacity reservoir, power house, incl. six 24,000 hp. turbines; 1,275 ft. Belvidere Dam, with power house, incl. 5 11,600 hp. units, and 38,900 acre ft. reservoir; Chestnut Hill Dam 840 ft., with power house and 10,900 acre-ft. reservoir.

Missouri — RURAL DISTRIBUTION LINES—Ozark Electric Co-operative, Mt. Vernon, rural distr. lines, Lawrence, Barry, Christian, Dade, Greene, Jasper and Stone Counties. **$483,000.** Frank Horton Eng. Co., Lamar, consult. engrs.

South Carolina—Black River Electric Co-operative, Sumter, 317 mi. rural distr. lines, Sumter and Clarendon Counties. **$565,000.** Southern Eng. Co., 699 Spring St., Atlanta, Ga., consult. engr.

Tex., Dallas—Dallas Power & Light Co., Dallas Power & Light Bldg., 60,000 volt transformer station, Westmoreland in Oak Cliff. **$650,000.**

Utah, Provo—City, c/o I. G. Bench, recdr., voted bonds enlarging municipal power plant. **$1,250,000.** Elmer Jacobs, Provo, engr.

Low Bidders & Contracts Awarded

California — Bureau Reclamation Dpt. Interior, bldg. 1-a, Denver Federal Center, Denver, Colo., Oct. 24, 230 kilovolt transmission lines, Shasta to Cottonwood —Gas Point Rd. and Keswick tap lines, Central Valley Proj., Spec. 1967, from Abbett Electric Co., 472 Tehema St., San Francisco. **$587,383.** Proposed work reported 10/18, p. 22.

Missouri—Southwest Electric Cooperative, R. H. Cochran, mgr., Bolivar, about 100 mi. rural distr. lines multi-phase feeders and conversion, St. Clair, Greene, Camden, Hickory, Benton, Polk and Dallas Counties, force account. Approx. **$200,000.**

N. M., Taos—Kit Carson Electric Cooperative, Taos, power plant, from E. Montgomery, Taos. **$68,000** Proposed work reported 10/11, p. 77.

North Dakota—Oliver Mercer Electric Co-operative, Hazen, addnl. 207 mi. rural distr. lines, Mercer Co., to Center Constr. Co., Center. Approx. **$215,000.** Banister

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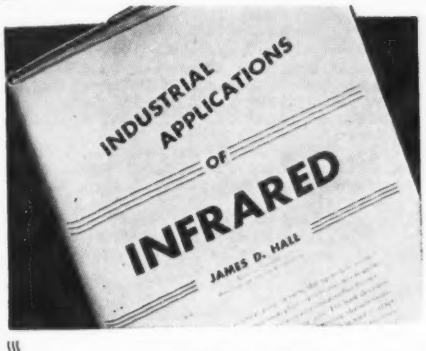

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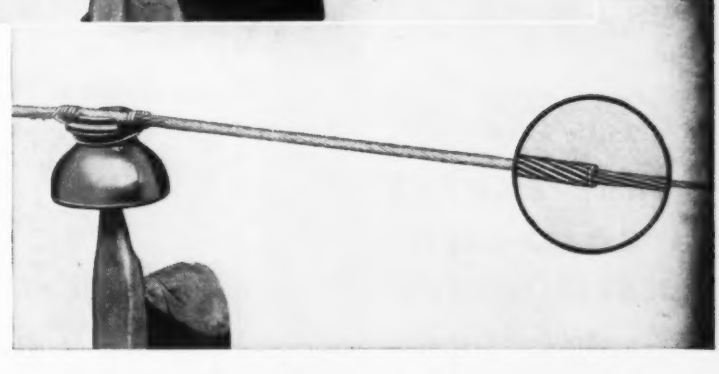

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LINE CLEARING

Eng. Co., 1549 University Ave., St. Paul, Minn. engr.

South Dakota—Lake Region Electric Co-operative, Webster, addnl. 207 mi. rural distr. lines, Day Co., to Zontelli Bros., Ironton, Minn. Approx. **$215,000.**

Texas—City Pub. Service Bd., 201 N. St. Marys St., San Antonio, 11 mi. 138,000 volt underground electric cable from New Braunfels south toward San Antonio, Comal and Bexar Counties. Purchase and Hire. **$700,000.**

INDUSTRIAL COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Calif., San Diego—Bd. Educ. Administration Bldg., plans by Kistner & Curtis, Spreckels Theatre Bldg., Hoover High School addn., **$525,000;** plans by Jackson & Hamill, Bank of America Bldg., Southeast Junior and Senior High School, 49 and Imperial Sts. **$1,000,000;** plans Point Loma High School, **$266,200;** LaJolla High School, **$746,200;** Pacific Beach Junior High School, **$415,000;** College Heights Junior and Senior High School, 45 and El Cajon Sts., **$750,000;** Educational Center, **$750,000.**

N. Y., Buffalo—Hewitt-Robins, Inc., Kensington Ave., plant addn. **$600,000.**

Okla., Norman—Bd. Regents, Norman, four 4 story, 38x232 ft. dormitories, incl. dining halls, lockers, storage, caretakers quarters etc. for girls. $2,500,000. Plans deposit $50. Sorey, Hill & Sorey, 1st Natl. Bldg., Oklahoma City, archts.

Pa., Tyrone—J. C. Yenter, agt., Tyrone Hospital, Tyrone, 2 story, bsmnt., brick, tile, steel hospital, Clay Ave. $500,000. Hunter & Caldwell, 3601 5 Ave., Altoona, archts.

Tex., Dallas—Southwestern Bell Telephone Co., c/o C. L. Stewart, mgr., 308 S. Akard St., 3 story masonry telephone bldg. addn., Haskell and Bryan Sts. **$1,000,000.**

Low Bidders & Contracts Awarded

Calif., Burbank—Unified School Dist., 245 E. Magnolia St., stucco school, to E. C. Messer & Johnson, 4822 W. Jefferson St., Los Angeles, **$652,152.** Est. $650,000. Low Bidder reported 10/18, p. 22, different Low Bidder.

Ill., Charleston—State, Springfield, general contract library, at Eastern Illinois State Teachers College, to J. L. Simmons Co., Inc., 2146 N. Woodford St., Decatur, **$1,459,710*****metal library equip., to Art Metal Constr. Co., Jones and Gifford Ave., Jamestown, N. Y., **$111,098*****electrical work, to Anderson Electric Co., 42¼ N. Vermilion St., Danville, **$225,240*****heating, ventilating and plumbing, to H. P. Reger & Co. 1501 W. 72 Pl., Chicago, **$190,351,** grand total $1,986,399.

Ill., Urbana—State Div. Architecture & Engineering, Armory Bldg., Springfield, general contract, Natural Resources Bldg. addn., to Kuhne-Simmons Co., Inc., 106¼ S. Neil St., Champaign, **$1,076,058***** heating and ventilating to Robert E. Murphy Co., 864 N. Sedgwick St., Chicago, Zone 10, **$201,642*****plumbing, to Economy Plumbing & Heating Co., 1308 S. Pulaski Rd., Chicago, **$148,000*****electric wiring, to Garden City Eng. Co., 1714 S. Halsted St., Chicago, Zone 8, **$235,827.** Grand total $1,661,527. Bids 9/16, awarded 10/27.

Ind., Indianapolis—International Harvester Co., A. M. Bowers, mgr., 5565 Brookville Rd., 1 story, 69,700 sq. ft. floor area, brick, rein.-con., steel factory addn., inc. machine shop and assembly room, 2,900 ft. loading dock, concrete roadway, to O. W. Wise, 2537 Burton Ave. Est. **$1,300,000.** Award 10/25.

N. Y., Cambria Heights—Supt. School Bldgs., Design & Constr., 49 Flatbush Ave. exten., Brooklyn, Zone 1, general construction P. S. 176, 235 St. and 121 Ave., to Gerace & Castagra, Inc., 1711 Sheepshead Bay Rd., Brooklyn, Zone 29, **$1,273,890*****plumbing, to Novak & Rehner, Inc., 623 10 Ave., New York, Zone 19, **$109,467*****heating, to Raisler Corp., 129 Amsterdam Ave., New York, Zone 23, **$190,780*****electrical work, to John G. Hellman, 391 Fulton St., Brooklyn, **$110,650.** Grand total $1,684,887. Bids 10/16.

Wash., Medical Lake—State Dpt. P. Institutions, Olympia, Oct. 22, general contract 2 story, rein.-con. senile ward bldg. at Eastern State Hospital, from Kuney Johnson Co., 235 9 Ave. N., Seattle, **$1,472,900;** mechanical work, from Arnold & Jeffers, N. 1309 Ash St., Spokane, **$535,912.**

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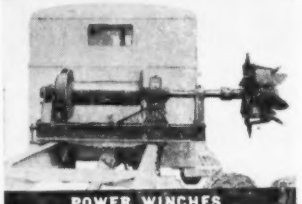

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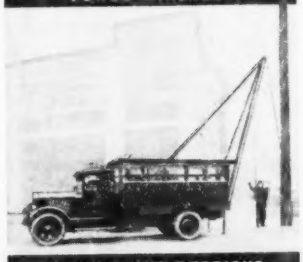

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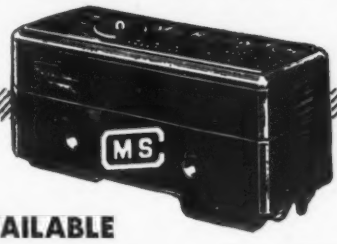

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Recent Rate Changes

OKLAHOMA GAS & ELECTRIC Co has been granted permission by the state Corporation Commission to reduce its rates to rural customers. The reduction amounts to an overall saving of $92,700 to some 8,567 rural customers.

CHESTERTOWN ELECTRIC LIGHT & POWER Co, Chestertown, Md., will reduce its rates to domestic consumers, according to a statement made by H. I. Thompson, president of the company. Negotiations toward a downward revision of rates will be completed with the state Public Service Commission within a short time. Mr. Thompson said that while the exact amount of the reduction cannot be determined until the investigation is finished, the commission has indicated that it will probably be in the neighborhood of $8,000 a year.

CAROLINA POWER & LIGHT Co, Raleigh, N. C., has been authorized by the South Carolina Public Service Commission to put into effect "more liberal" electric water heating rates for the Pee Dee section of South Carolina. The new schedule was authorized for residential electric customers, who have water heaters meeting specifications in Chesterfield, Darlington, Dillon, Marion, Florence, Kershaw, Sumter, Fairfield, Clarendon and Lee counties.

NORTHWESTERN ELECTRIC COOPERATIVE, INC, Woodward, Okla., has reduced electric rates $5,000 on an annual basis.

•

Elastic Stop Nut Purchases Interest in Buchanan

Purchase of a majority stock interest in the Buchanan Electrical Products Corp, Elizabeth, N. J., by Elastic Stop Nut Corp of America, Union, N. J., has been announced by W. F. McGuinness, president of the latter company. The purchase of this interest, he said, was a step in the company's long-range program to add to its present products new lines which would permit diversification of factory output.

Buchanan Electrical Products has been active in the design and distribution of electrical fittings and specialty wiring devices to wholesalers and large industrial users for a number of years.

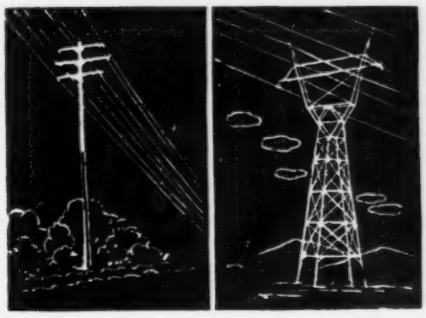
Operations of the two companies will be coordinated with a new line of insulated bushings and other improved electrical fittings which will be manufactured by Elastic Stop Nut Corp of America and sold through the Buchanan organization.

•

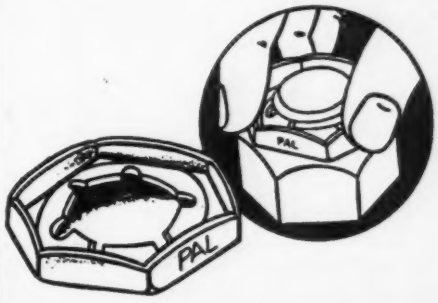
New Lamp Life Rating

An increase in average rated life of 25 percent for the 3,000-watt, 120,000-lumen, A-H9 mercury vapor general lighting lamp and 33⅓ percent for the B-H9 photochemical lamp has been announced by the Westinghouse Lamp Division, Bloomfield, N. J.

ELIMINATE RE-TIGHTENING OF NUTS
On Steel Tower and Wood Pole Lines



Specify "Palnuts" on new lines
Add "Palnuts" to existing lines



For over 10 years, Double Locking "Palnuts" have been keeping bolt-and-nut assemblies tight on steel towers, wood pole lines, cross arms and braces, insulator pins, clevises and clamps.

When applied on new installations, "Palnuts" save future checkups and re-tightening. Maintenance crews checking old installations can add "Palnuts" without disturbing regular nut. Only 3 bolt threads space are required. "Palnuts" are very low in cost; may be removed and reused. They are available in a full range of sizes, in Hot Dipped Galvanized or other finishes and materials used by the Utility industry.

SEND details of your needs for samples. Write for "Palnut" literature and detailed folder on power line applications.

THE PALNUT COMPANY
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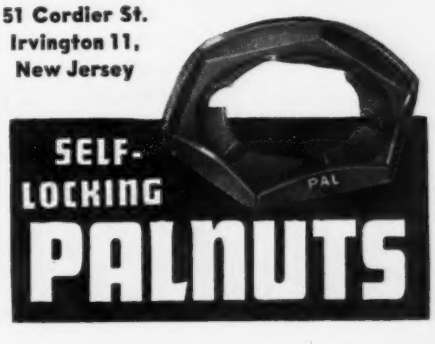

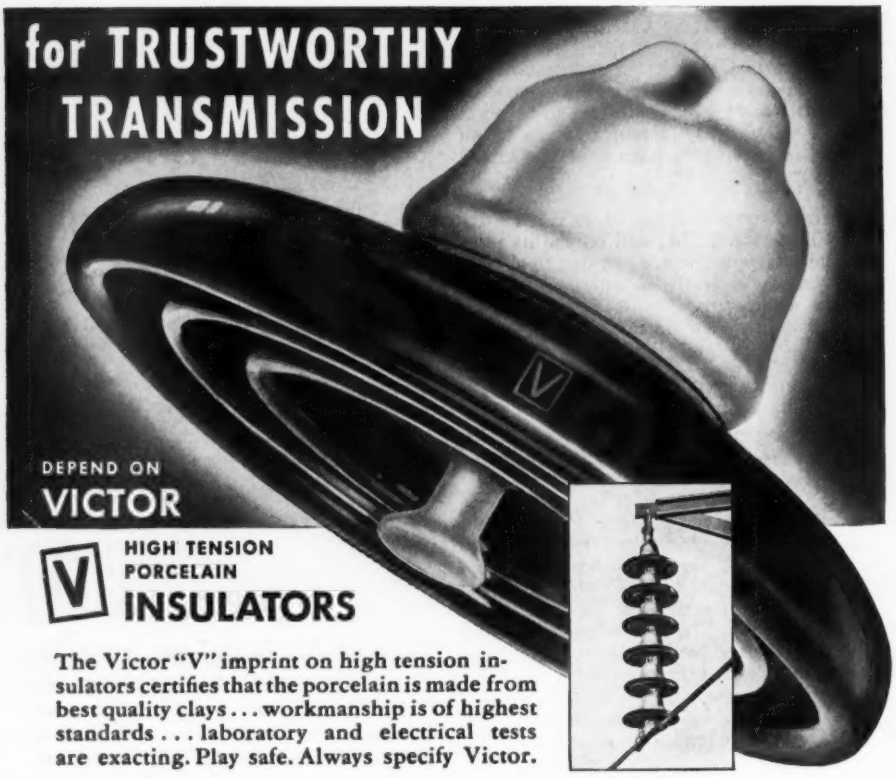

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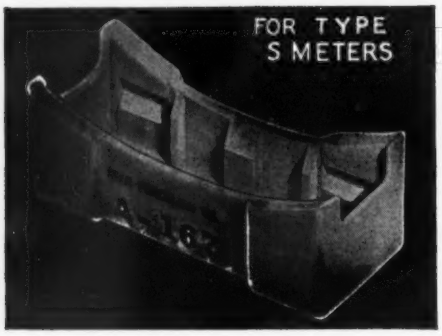

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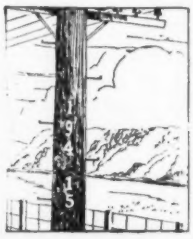

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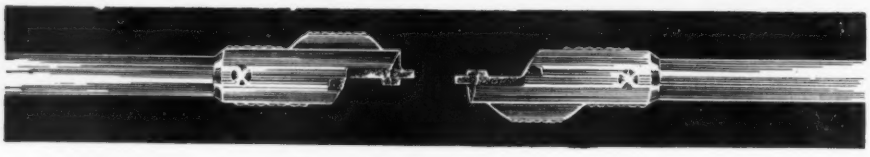

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500-Kv Test Program

(Continued from Page 95)

standard commercial ratings.

Two different type arresters were installed at the test station to protect the transformer. Both are electrically alike. Since the 500-kv test system has a solidly grounded neutral, the arrester rating decided upon was 350 kv, 70 percent of maximum phase-to-phase voltage. This is a lower rating than the usual 80 percent and was chosen because of the probability that consideration will be given to arresters with less than 80 percent voltage rating for future solidly grounded extra-high-voltage systems. A ratio as low as 70 percent will give significant operating experience.

Because of the high maximum rating of 350 kv, conventionally designed arresters would be excessively high. To keep down height, two different arrester arrangements were used: One, a suspended design, swung units from a steel frame in vertical zigzag fashion between strings of insulators; the other, a self-supporting three-legged design, consisted of mutually braced columns consisting of alternate arrester sections and insulating units. Active arrester units in the three columns are interconnected spirally.

High-Voltage Switchgear

The high-voltage switchgear equipment provided for the test station will consist of a 10,000,000-kva power circuit breaker of the oil-blast type, isolating disconnecting switches, protecting lightning arresters, relays, interlocks, coupling capacitors and bushing current transformers. All these components will be interconnected and assembled on a supporting framework as an integrated switching unit.

In deciding upon the type of circuit breaker to be used for the high-voltage testing station, the low-oil content impulse type breaker developed for the 287-kv Boulder Dam line seemed to be the most promising type.

The experimental breaker has a three-phase interrupting rating of 10,000,000 kva at 360 kv, the highest interrupting rating of any breaker to date.

In operating, a compressed air mechanism drives the main operating rod. It passes up through an oil-filled vertical porcelain column. A

piston at top of the column operates at the same time as the contacts to force oil out into a horizontal interrupter tube and between six sets of series contacts to effect arc interruption. Large shielding rings at either end of the interrupting tube divide the voltage uniformly.

Test Set Up

In general two types of tests will be conducted on the lines. One group will be voltage versus corona loss curves for various conductors, spacings and ground wire heights under varying atmospheric conditions and conditions of conductor surface. The other group will be long-time tests in which the corona losses will be recorded graphically.

The two long test lines will be used for long-time tests for more accurate corona loss curves and for radio interference measurements. The short one-span line will be used to obtain information on various types of conductors, where it is impractical to change the long lines.

One wattmeter will be used to measure the power in each phase of each line so that a total of nine wattmeters is required.

As it is desirable to test several circuits simultaneously, the metering equipment on each phase consists of the following: One voltmeter to indicate metering winding voltage, three ammeters to indicate individual line-charging currents, three current balance transmitters together with three milliammeters to indicate power loss, two slow-speed (3 in. per hr) and one high-speed (90 in. per hr) graphic milliammeters to record the corona loss. The range of the wattmeters is from 100 watts to 60 kw per phase. The instruments and auxiliary equipment used in measuring the corona loss on one phase are shown.

•

Iron-for-Iron Exchange

Under the terms of a new policy now in effect, General Electric Co's dealers are offering their customers an iron-for-iron exchange for those designated irons which fail under the terms of the warranty, M. B. Ross, manager of the company's heating device division, has announced. The new exchange policy makes it possible for customers to return specified General Electric irons which have failed to perform according to guarantee and to obtain new ones from their dealers.

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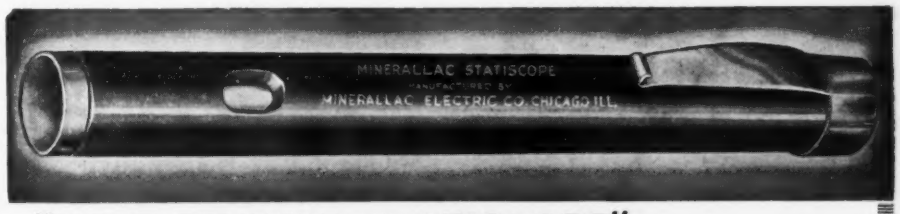

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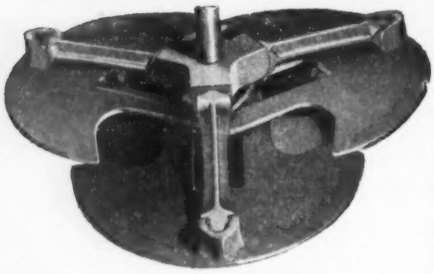

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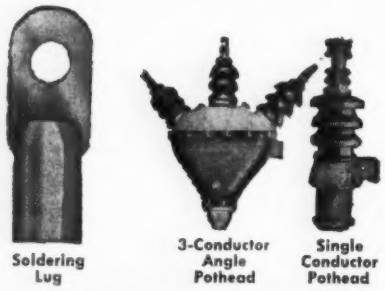

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Rewinning the Campus

(*Continued from page 97*)

and get acquainted with the students enrolled in the branches. See that they are invited to section meetings at which papers on power topics are presented. That is all prior to the matter of formal recruiting but no less important.

The electric utility scouts who scour the campus for engineering recruits will find the competition there in force. It has been there for years —without the 20-year hiatus which has disrupted utility recruiting so widely. The competition, in short, has some pretty expert hunters beating the same bushes. To get its share of the "game," the utility industry will have to send out pretty capable hunters also. In Table V are some pointers on "bagging the beast":

Table V—Bringing Home the Engineers

1. **Have your personnel men at the colleges no later than mid-spring.**
2. **Be certain that your college visitors are well-informed, imaginative and enthusiastic about the power industry.**
3. **Can they refute effectively the idea that electric utility technology is on a plateau of maturity?**
4. **Be sure that they can match each glamorous aspect of "light current" with a challenging phase of "heavy current" work.**
5. **Have them emphasize that electronics work within the 60-cycle field has real opportunities.**

A recruiting program, of course, aims at getting enough of the best possible men. But any such campaign would be pointless if an industry's manpower trickled out at one end as rapidly as it was siphoned in at the other. Thus, recruiting must be followed with personnel practices, of every description, which will hold men on their jobs—and keep them enthusiastic. Indeed, the continuing attractiveness of a job is a prominent factor in the success of one's recruiting efforts. Assistance in estimating

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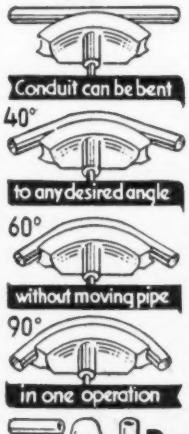

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Industry buys more

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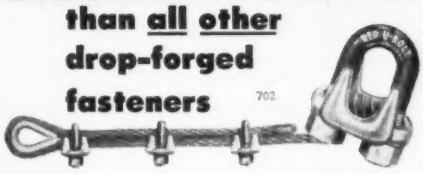

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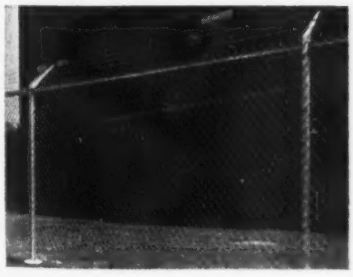

Stewart Style 3TH Chain Link Wire Fence as illustrated offers the utmost protection for all types of industrial property. This fence is also available in style 5TH which carries five strands of barbed wire. Other Stewart products for industrial use include: Iron Picket Fence and Entrance Gates; Wire Mesh Partitions; Wire and Iron Window Guards; Steel Folding and Sliding Gates; All Steel Settees; Flagpoles; Wire Trash Baskets, etc. When writing for literature please mention products in which you are especially interested.

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Stewart IRON and WIRE FENCES

the possibilities of keeping men you recruit may be had from Table VI.

Table VI—Keeping Them Happy

1. Give your recruits well-organized cadet training courses.

2. Make sure that your new men do not lose their enthusiasm through contact with men who are unenthusiastic about their own jobs.

3. What possibilities do you find for working with manufacturers to train your recruits?

4. Is your program one which can be sold to the prospect as promising sustained interest and supervision, and one which recognizes capabilities?

Admittedly, many of the early technical problems of power systems have been solved. So have many in radio, radar and television. But just as these fields present challenges for advancement, so does the 60-cycle power field. One trouble is that they are not widely enough recognized as being challenges. Another trouble is that there are not as many engineers among electric utilities as there should be who are enthusiastic enough about them to infect the young prospect with enthusiasm about them.

There is no dearth of problems in the realm of power generation, distribution and utilization. The deficiency lies in the minds and moods of those who are working on current phases of those problems. Present utility staffs are generally too modest and restrained about them, perhaps, because they look for the immediate answer rather than the envisioned projection.

Power industry jobs afford plenty of opportunity for untrammeled minds, for ambitious souls, and for pioneering spirits. All it will take is enough enthusiasm on the part of scouts and interviewers. From this enthusiasm can come a flow of new talent that will sense these challenges and grasp the opportunities. From it will come the brains the industry will be needing as it doubles and trebles while the present brains are retiring from activities.

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